Making and Selling Cars

Innovation and Change in the U.S. Automotive Industry

James M. Rubenstein

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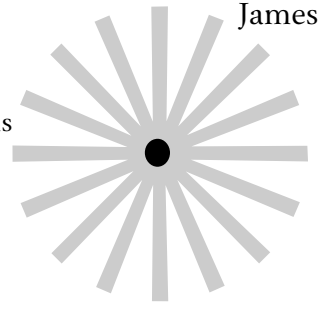

The Johns Hopkins
University Press
Baltimore & London

© 2001 The Johns Hopkins University Press
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Printed in the United States of America on acid-free paper

9 8 7 6 5 4 3 2 1

The Johns Hopkins University Press
2715 North Charles Street
Baltimore, Maryland 21218-4363
www.press.jhu.edu

Library of Congress Cataloging-in-Publication Data
Rubenstein, James M.
Making and selling cars : innovation and change in the U.S. automotive industry / James M. Rubenstein.
p. cm.
Includes bibliographical references and index.
ISBN 0-8018-6714-2
1. Automobile industry and trade—United States. I. Title.
HD9710.U52 R836 2001
338.4'76292'0973—dc21
00-012496

A catalog record for this book is available from the British Library.

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PREFACE

A house is for sleeping, a car is for living.
—Attributed to Joost Dijkhuizen, Niels Wisse, and Bert Robben

DURING the century just ended, Americans walked on the moon and split the atom. They invented miracle seeds that could feed the world, and nuclear weapons that could destroy it. But no invention contributed more to transformation of life in the United States in those years than the motor vehicle.

In 1900 the United States contained two thousand motor vehicles and twenty million horses. In 2000 the nation had more motor vehicles than licensed drivers. The development of the motor vehicle revolutionized American systems of production and patterns of consumption. Heading into the twenty-first century, the motor vehicle led yet another revolution, overturning the systems of production and patterns of consumption that had dominated the nation in the previous hundred years.

This book examines this twentieth-century revolution and the prospects for further transformations in coming years. The book is organized into six pairs of chapters. The first three pairs discuss the most important changes in production brought about by the motor vehicle early in the twentieth century and how these changes continue in the early years of the new century. The next three pairs of chapters discuss the contributions of the motor vehicle to changes in consumption over the past hundred years and how these changes continue. Around 1900 the mass production revolution instigated changes in consumption. In contrast, around 2000 changes in consumption were triggering changes in production. The odd-numbered chapters, all beginning with the word *From*, discuss production and consumption revolutions in the motor vehicle industry during the

first years of the twentieth century. The even-numbered chapters, all beginning with the word *To*, address the changes in the recent past and also look ahead to the near future.

Mass production was not invented by the automotive industry, nor was the motor vehicle even invented in the United States. But the U.S. automotive industry accomplished far more than industry in any other country to bring together and refine the essential features of mass production. This book argues that the U.S. automotive industry made three distinctive contributions to the mass production revolution that replaced the craft system early in the twentieth century. First was the invention of methods for making large quantities of essentially identical products efficiently and inexpensively (chapter 1). Second was the creation of corporations that maintained tight control over all phases of a highly complex production process, from initial research to final sale (chapter 3). Third was the attraction, retention, and fashioning of a large supply of workers who were minimally skilled yet highly productive (chapter 5).

These three basic innovations of mass production served the U.S. automotive industry well for most of the century, but were rendered obsolete in recent decades by the spread of Japanese-inspired lean production. As a result, motor vehicle producers had to figure out how to make efficiently and inexpensively a variety of widely varying models (chapter 2). To do so, they had to take apart their tight control over the development process and turn over much of the responsibility to independent suppliers (chapter 4). To grasp the complexities of contemporary motor vehicle production, carmakers had to hire skilled employees (chapter 6).

Within a generation of reaching the United States the lean production model had been severely altered into yet another form of production, emerging in recent years under the term *optimum lean production*. Optimum or post–lean production tempered lean production with elements of mass production.

The early revolution in mass production led by U.S. carmakers also revolutionized consumer demand. To be fully successful, mass producers had to figure out how to sell all the vehicles they were capable of making. Having created an effective demand for their products, they then could concentrate—as they did during much of the twentieth century—on tinkering with the mass production methods that provided the necessary supply. The U.S. motor vehicle industry revolutionized consumption in three ways. The first was the invention of a reason to turn in a very expensive and perfectly serviceable product for a newer and only slightly different

version (see chapter 7). Second was the amassing of a large sales force dedicated to aggressively marketing one specific and expensive product (chapter 9). Third was the creation of a culture that made universal ownership and use of motor vehicles the most distinctive element of national identity in the United States (chapter 11).

The pattern of consumer demand created by motor vehicle manufacturers in the United States collapsed at the end of the century. American consumers were no longer satisfied with the range of choice in motor vehicles that had sufficed for so long (see chapter 8). Longstanding methods of distributing motor vehicles to consumers no longer served the country's more socially heterogeneous buying population (chapter 10). A culture that stimulated demand for motor vehicles, no longer confined to the United States, diffused to other countries (chapter 12).

Thanks to Miami University student Joseph Schmidt, who prepared drafts of most of the art, as well as all of my students in my Auto Industry class. This book is dedicated to my wife, Bernadette Unger, who as Planning Director of Oxford, Ohio, has to deal with Miami student cars, and to my parents, who taught me to drive a stick shift in a hilly neighborhood.

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1 *From Fordist Production . . .*

Why don't we assemble the motors like they kill hogs in Chicago?
—C. Harold Wills, chief engineering assistant at Ford Motor Co., 1912

The Michigan Historical Commission designated the Ford Motor Company's former Highland Park plant a historical site in 1956. The historical site marker reads: "Home of Model T. Here at his Highland Park Plant, Henry Ford in 1913 began the mass production of automobiles on a moving assembly line. By 1915, Ford had built a million model T's. In 1925, over 9,000 were assembled in a single day. Mass production soon moved from here to all phases of American industry, and set the pattern of abundance for 20th Century living."

The term *Fordism,* or *Fordist production,* recognizes the central role of automobile manufacturers, especially the Ford Motor Company, in creating the twentieth century's dominant mode of industrial production. The power of the term *Fordism* comes from two reinforcing elements: first, the overwhelming success of the mass production techniques pioneered at Ford; and second, the towering personality of Henry Ford himself as a principal spokesman, personification, and philosopher for the industrial age.

Contemporary revisionists play down the importance of the moving assembly line. "Although Ford's achievement is popularly attributed to his introduction of the assembly line, this was only a small part of the revolution. . . . There was nothing original in either the detail or the general principles which Ford applied to automobile production."[1] The moving assembly line was first used in Cincinnati and Chicago, in the slaughterhouses of the meat-packing industry, where hog carcasses were brought on overhead trolleys past each worker, who took his cut. Similarly, Minneapolis flour-milling firms used automated systems to move grain through milling operation.

Looking back on Fordism, contemporary writers often deemphasize the importance of Ford's mass production innovations, and the force of the man himself has faded into history. Yet the production processes introduced at Ford remained remarkably unchanged until the end of the century, and Henry Ford's words and deeds shaped much of the industrial era. It has been said that Ford's moving assembly line "inaugurated a new epoch in the industrial history of modern society. Many centuries before, Archimedes, exulting in his invention of the lever, had declared that if he had a fulcrum he could move the world. Mass production furnished the lever and fulcrum which now shifted the globe."[2]

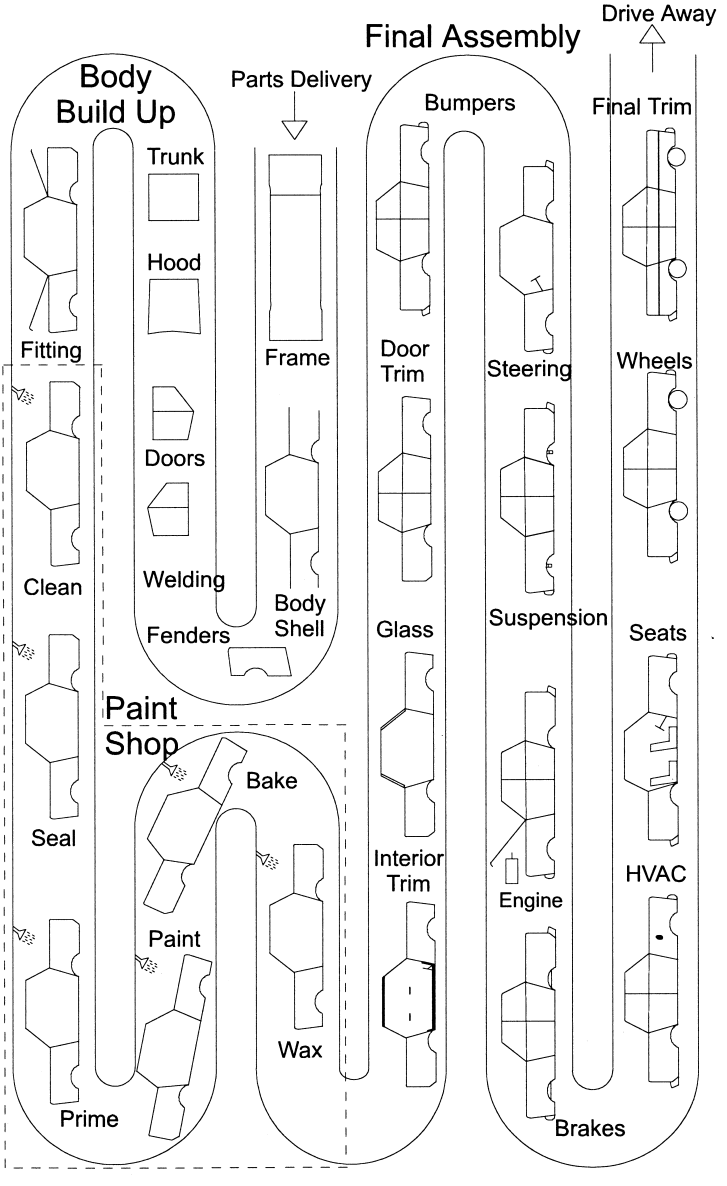
The process of assembling motor vehicles changed little over the decades following Ford's mass production revolution. The body and chassis were built on separate lines within the final-assembly plant and then brought together near the end. On the chassis build-up line, most of the powertrain components—such as the engine, transmission, steering gear, driveshaft, differential, brakes, axles, wheels, tires, springs, and exhaust—were attached to a frame. Meanwhile, on the body build-up line, body panels were welded together, the doors were installed, the body was painted, and passenger compartment components—such as windshields, seats, instrument panel, steering column, heater, and radio—were attached. Near the end of the assembly line, the body was dropped onto the chassis, and the vehicle received additional components, such as radiator, fenders, hood, battery, and bumpers (Fig. 1.1). Completed vehicles were tested and inspected before being driven out of the building for shipping.

Beginning in the 1960s most cars and some trucks were assembled through "unitized" construction. In the body build-up operations, the body sides, roof, and fenders were welded to the frame, and doors, hood, and trunk were fitted. The body was taken to the paint shop for chemical treatment, protective sealing, and painting, and the doors were removed. On the final-assembly line, the engine, transmission, glass, instrument panel, seats, and other interior components were attached, then the doors were reattached. Unitized construction resulted in vehicles with fewer shakes, rattles, and rolls than vehicles assembled through the old "body-drop" approach. Final-assembly plants were rearranged rather than fundamentally redesigned to accommodate the new procedure (Fig. 1.2).

The moving assembly line still fascinates visitors, as a maze of belts and chains delivers a never-ending succession of parts, some painted different colors and others all alike. The sequencing of the line appears bewildering, in part because tours invariably begin in the middle or near the end of the

1.1. Final-assembly line, Flint, Michigan: attaching hood to Buick, 1955. (National Automotive History Collection, Detroit Public Library)

line, never at the beginning. Logically, the line begins near the loading docks rather than near the visitors' parking lot and entrance. The impression is of a single, vast, complex, synchronized machine, rather than a discrete collection of intelligible operations. Almost magically, operating vehicles are driven off at the end of the line.



1.2. Final-assembly plant layout. The typical assembly plant in 2000 was divided into three sections: (1) the body is welded together in the Body Build Up area; (2) the body is painted in the Paint Shop, shown in dashed outline; (3) the components and trim are installed in the Final Assembly area. (Adapted by the author from multiple sources)

Perhaps most remarkable of all, installing the moving line during the 1910s cost Ford less than $3,500. The final-assembly line was simply two strips of metal plates, mounted on a belt. At the end of the line the strips rolled under the floor and returned to the beginning.

Fordism and the Ford Motor Company

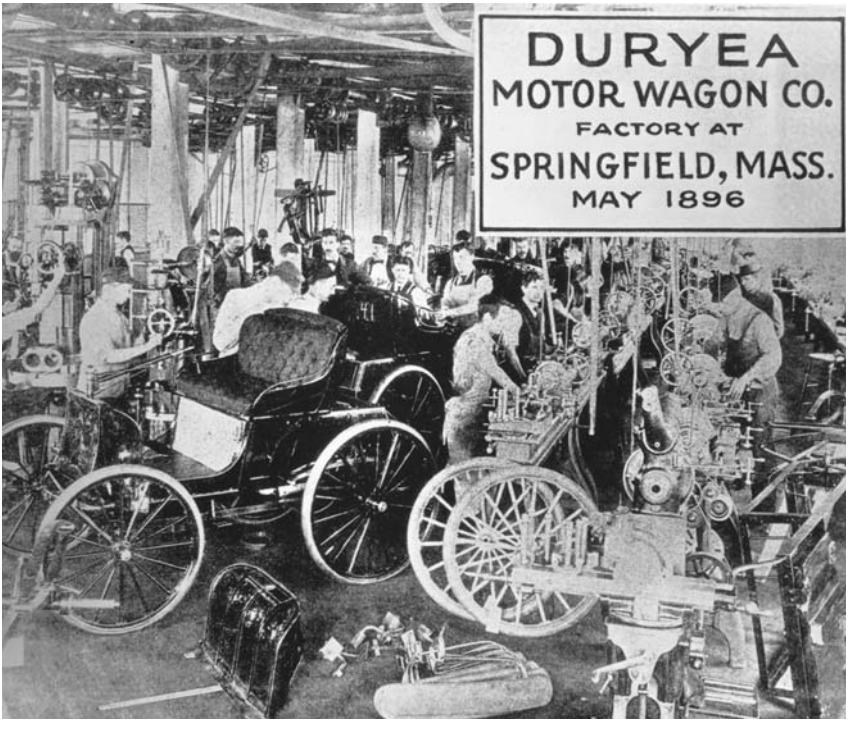
Looking back today, the strategy for creating a mass market for a new product in the early twentieth century seems obvious: invest in technological innovations that drastically reduce production costs, and pass the savings on to consumers. Despite lower prices, profits would increase because of the much larger volume of sales. This strategy worked repeatedly over the decades: to take a more recent example, microwave ovens and desktop personal computers were transformed from exotic expensive toys to affordable, nearly universally owned necessities this way. But in its day the approach defied conventional wisdom.

When Henry Ford entered the car-making business in 1899, the optimal manufacturing strategy was to concentrate production on a small quantity of relatively expensive products and sell them at a high markup (Fig. 1.3). The belief was that one should expand production only gradually, if at all. At small volumes, manufacturers could sell all they made, because demand for cars far outstripped supply. A rapid increase in volume of production made no sense, because a glutted market would depress prices and profits.[3]

Early producers believed that to sell motor vehicles, they had to create sensations, such as high-speed races or long-distance endurance trips through harsh terrain. Henry Ford himself first gained prominence among automotive enthusiasts by racing the cars he built, to the point that his backers withdrew support for his company, believing that he was not devoting enough time to producing models for sale to the public. But the daredevils were wrong: people were not merely fascinated at the spectacle of a machine that could go remarkably fast or ascend the capitol steps, they very much wanted to own one themselves. The appeal of the motor vehicle was so great that it would not be restricted to a plaything for the rich. Once people were able to buy vehicles, they figured out all sorts of things to do with them, including many practical applications.

Ford's Practical, Low-priced Vision

Henry Ford's marketing genius was to recognize that the desire to own a motor vehicle was nearly universal. Because vehicles quickly captured



1.3. Duryea Motor Wagon Company factory, Springfield, Massachusetts, 1896. Duryea was the first commercial producer of motor vehicles in the United States. In early assembly plants, work was brought to the machine tools; a decade later Ford organized assembly operations in logical sequence and placed machine tools where needed. (National Automotive History Collection, Detroit Public Library)

public imagination thanks to their speed and performance, early producers assumed that the market was primarily for the recreational and leisure purposes of the wealthy. Ford, however, believed that a vast market existed among poorer people for an inexpensive vehicle. He saw that the key to making inexpensive vehicles was to change the production process.

Ford was not the first to build a low-priced car. The Olds Motor Works introduced the Curved Dash model in 1901, with a base price of $650. In the words of the company's founder Ransom E. Olds, "My whole idea in building [the Curved Dash] was to have the operation so simple that anyone could run it and the construction such that it could be repaired at any local shop."[4] The Curved Dash was 98 inches long, weighed 700 pounds, and was powered by a 4.5-horsepower, 95.5-cubic-inch, one-cylin-

der engine, connected to a two-speed planetary gear and single chain transmission. At the model's peak of popularity in 1903, Olds sold 4,696 Curved Dashes, one-fourth of all U.S. car sales.

Henry Ford's first two attempts to set up a car-making company failed. The Detroit Automobile Company, established in 1899, built a couple of dozen vehicles before closing in 1900. Reorganized as the Henry Ford Company in 1901, the firm failed again within a year. Ford himself claimed that his financial backers had given up on him too quickly, while his critics charged that he was more interested in racing cars than in building them. The Henry Ford Company hired the head of Detroit's most successful machine shop, Henry M. Leland, to run the company, renamed the Cadillac Automobile Company. The Ford Motor Company, Henry Ford's third and ultimately successful attempt to make cars, was founded in 1903.

Henry Ford's priority, from the founding of the Ford Motor Company in 1903, was to build the best-selling low-priced model, but he clashed with his principal financial backer and company treasurer, Alexander T. Malcomson, who preferred more expensive cars. Ford needed Malcomson's money to get started, because after his earlier, unsuccessful car-making ventures he was unable to borrow money from Detroit banks. The two men had begun their acquaintance some years earlier. One of Ford's jobs when he worked at Edison Illuminating Company during the 1890s had been to buy coal, and Malcomson was a leading Detroit-area coal merchant who sold his products with the slogan "Hotter Than Sunshine." Malcomson's insistence on building the more expensive models disturbed Ford, who saw the company moving away from his goal of building a car that could be sold for $500. The weight of evidence at the time, however, favored Malcomson's position: the median price for a new car rose from about $1,000 in 1903 to $1,500 in 1905, and to $2,000 in 1907. Only 2 percent of cars sold for less than $675 in 1907.[5]

The dispute between Henry Ford and Malcomson came to a head in 1906, when Ford set up a second company, the Ford Manufacturing Company, to make components, reducing the Ford Motor Company's dependence on independent suppliers. He financed the new project by reducing Ford Motor Company dividends from $100,000 in 1905 to $10,000 in 1906. Malcomson opposed slashing the dividend, because it was his only source of income from the company, while Ford received a salary as vice president. Ford and Malcomson both held equal shares of the company, but Ford won out thanks to the support of the smaller shareholders, who backed his plan. Malcomson lost credibility with the other members of the

board of directors when he reacted to the reduced dividend by investing in a competing car maker, Aerocar. He was asked to resign as the treasurer and a director of the Ford Motor Company in 1906. Henry Ford bought Malcomson's roughly one-quarter interest in the company for $175,000. A year later the Ford Manufacturing Company was merged into the Ford Motor Company, with Henry Ford holding both managerial and financial control of the enterprise.

With Malcomson gone, Henry Ford could concentrate on building an inexpensive car, beginning with the four-cylinder Model N, introduced in 1906 at a price of $600. Although Ford had not yet achieved his goal of profitably selling a $500 car, the Model N was greeted enthusiastically, and Ford sales rose from 1,599 in 1905 to 8,729 in 1906, 14,887 in 1907, and 10,202 in 1908. The successor to the Model N, the Model T, was priced at $650 on its introduction in 1909. After installing the moving assembly line in 1913, Ford finally hit the $500 target. In its last year of production, in 1927, a Model T could be purchased for just $290.

Sales of Ford cars grew rapidly, but demand increased even faster. Ford Motor Company sold 189,088 cars in 1913, yet still had 102,000 unfilled orders. To meet the growing demand, the company was constantly tinkering with production methods. Through trial and error over a few months in 1913 and 1914, Henry Ford and his associates figured out how to expand production. As production increased, demand increased even more rapidly, because lower unit costs permitted Ford to reduce prices even further. Motor vehicle production in the United States increased from 314,000 in 1912 to 1.9 million in 1917; the Ford Motor Company accounted for no less than half of that growth.

Fighting the Monopoly

The gravest threat to Ford's vision of a mass-produced $500 car during those early years was the Selden patent. In the words of Horace H. Rackham, an attorney and a director and minority shareholder of Ford Motor Company, "the Selden Patent case was always a matter of most serious concern to all of us. We all realized that until it was disposed of it placed the entire fortune of the Ford Motor Co. and the rest of us in hazard."[6] In the estimation of John Anderson, also an attorney and a Ford director and shareholder, the Selden patent case, "until it was won, threatened the life of [the Ford Motor Company]; and had it been lost, it would have rendered [Ford] stock worthless."[7]

The story begins in 1879, when George B. Selden, a Rochester, New

York, inventor and patent attorney, saw Joseph Brayton demonstrate the two-stroke gasoline engine he had invented. Selden made drawings and a model of what he called a "road-locomotive," powered by an engine similar to the Brayton design, and sent them with his application to the U.S. Patent Office in Washington, D.C. Because a patent is issued for only seventeen years, Selden made minor changes and amendments to his application every year to delay its formal registration until November 5, 1895, a few months before the start of commercial motor vehicle production in the United States.

Selden was granted U.S. patent number 549,160 for "the application of the compression gas engine to . . . horseless carriage use." Selden's application accurately anticipated in very broad terms the essential elements of an automobile: a vehicle powered by a liquid hydrocarbon (presumably gasoline) engine that produced compression in cylinders, connected by a power shaft (a crankshaft) to wheels that could be steered, with a disconnecting device (a clutch) to vary the speed, and mounted with a carriage body suitable for conveying people or goods. Although he did not actually build an operable car, Selden claimed to have invented the concept by uniquely combining other inventions.

Selden argued that the patent gave him the right to collect a royalty on every car sold in the United States through 1912 and to restrict production so that the prices—and therefore royalties—would remain high. Lacking time and money to enforce his patent, Selden assigned it in 1899 to a group of Wall Street investors, headed by William C. Whitney, a former secretary of the navy, for $10,000, plus a share of royalties. The financiers also bought the Electric Vehicle Company, which specialized in taxicabs, and merged it with the Columbia Automobile Company, owned by Col. Albert Pope. The Columbia electric car accounted for more than 40 percent of all U.S. automotive sales in 1899, and the following year Columbia became the first carmaker to exceed 1,000 in annual sales. Pope, often known as the King of Bicycles, was also busy in 1899 setting up the American Bicycle Company as a trust to control forty-five other bicycle manufacturers.

The Electric Vehicle Company filed suit for infringement of the Selden patent against two car makers, two parts makers, and an importer between 1900 and 1903. The most prominent defendant, the Winton Motor Carriage Company, maker of the second best-selling car in 1901, and five other leading car makers (Knox, Locomobile, Oldsmobile, Packard, and Pierce-Arrow) reached a settlement with the Electric Vehicle Company in 1903 that acknowledged the patent's validity. The producers agreed to pay a

royalty of 1.25 percent of the sales price of each car they sold, an amount that was reduced in 1907 to 0.8 percent.

As part of the agreement, a trade organization called the Association of Licensed Automobile Manufacturers (ALAM) was formed to lease to its members the right under the Selden patent to manufacture and sell a limited a number of cars per year and to decide which companies should be sued for patent infringement. ALAM received two-fifths of the Selden patent royalties, to finance further enforcement of the patent against other companies. Another two-fifths of the royalties went to the Electric Vehicle Company, and the remaining one-fifth to George Selden.

When the Ford Motor Company was incorporated in 1903, Henry Ford met informally with ALAM's acting president Fred L. Smith, who was also treasurer of Oldsmobile, to discuss his prospects for receiving an ALAM license. Smith told Ford that his application would likely be turned down because the Ford Motor Company was "a mere assemblage place," rather than a full-fledged car manufacturer. Henry Ford reacted with "sulfurous vehemence." Other Ford officials counseled further negotiations, but at a later meeting with Smith positions hardened. After Smith presented ALAM's perspective, Ford business manager James Couzens reportedly roared: "Selden can take his patent and go to hell with it."[8]

His pride wounded, Ford went out of his way to pick a fight with ALAM by running defiant advertisements and sending scathing letters to trade publications. Aside from pride, Ford fought ALAM because he was committed to raising production and reducing prices, policies opposed by the association.

On October 22, 1903, Ford Motor Company was sued in the U.S. Circuit Court of Southern New York for infringement of the Selden patent. The case, argued by a battery of nationally prominent attorneys, produced a mountain of evidence, including a 14,000-page transcript filled with historically important testimony by automotive pioneers concerning early advances in the industry. The judge, who admitted knowing little about cars, ruled in 1909 that Selden had invented a good idea back in 1879, so the patent was therefore valid and binding on the Ford Motor Company. A year after it had introduced the Model T, Ford was made liable for unpaid royalties, totaling millions of dollars, on every one of the more than 50,000 cars it had sold since 1903.

Facing ruin, Ford appealed the district court ruling. The U.S. Court of Appeals (*Columbia Motor Car Company v. C. A. Duerr & Co.* 184 Fed. 493) upheld the Selden patent on January 11, 1911—for all vehicles built with Bray-

ton's two-stroke engine, as described in Selden's original patent request. But the court ruled that the Otto-type four-stroke engine—the one universally used by car makers, including Ford—was not covered by the Selden patent. The appeals court decision thus rendered the Selden patent worthless.

During the decade of its enforcement of the patent, ALAM collected $5.8 million in royalties. Virtually all U.S. car makers had joined the association and paid Selden patent royalties, including the recently formed General Motors, which was financially strapped and could ill afford the expense. After the adverse court ruling, ALAM quickly disbanded. A successor organization, the National Automobile Chamber of Commerce (originally Automobile Board of Trade), was founded in 1913 to promote cooperative exchange of information and cross-licensing of patents on individual components. All manufacturers except Ford Motor Company joined. However, Ford did cooperate with ALAM's Mechanical Branch, which became the Society of Automotive Engineers.

In the words of Rackham, "you cannot imagine how freed we all felt after the final decision against the validity of the Selden patent. It was then that we could extend the expansion policy which was Mr. Ford's dream and the sky was then the limit."[9] After winning the Selden patent case, according to Detroit attorney Arthur J. Lacey, who represented several Ford shareholders and directors, Ford Motor Company in June 1911 "began to make plans for a great expansion of their business—a tremendous expansion program, one which was probably never equaled in the history of America. . . . The only thing from then on that held the Ford Motor Company back was their ability to produce machines as fast as they could be sold."[10]

Mass Production at Highland Park

Ford began production at a new assembly plant in Highland Park, Michigan, on New Year's Day, 1911, ten days before winning the Selden patent case appeal. Albert Kahn, the most prominent industrial architect of the era, was credited with designing Highland Park, although Ford's chief construction engineer Edward Gray claimed that he had actually designed it.[11] The Highland Park complex was known as the Crystal Palace, because 75 percent of the building façade was glass. Two elements made Highland Park distinctive: First, the factory was designed from the start to facilitate production in a logical sequence of operations, based on the order in

which parts were required. Second, soon after its opening, the plant was fitted with moving assembly lines.

Highland Park was Ford's third assembly plant in less than a decade. The company started production in 1903 in a rented 12,500-square-foot building on Mack Avenue. The Mack Avenue factory was a large, open room, 250 feet by 50 feet, where a handful of workers assembled about ten vehicles a day, with parts bought from outside suppliers. Alexander Malcomson, Ford's principal backer, had persuaded the owner of the Mack Avenue building, Albert Strelow, one of the city's largest painting and carpentry contractors, to remodel the shop into an automobile plant, in accordance with Henry Ford's design. Rent was set at $75 a month for three years. In the 1930s Ford moved the long-abandoned Mack Avenue plant to Greenfield Village, a 93-acre collection of historic structures he established in Dearborn that is now Michigan's most popular tourist attraction.

One year to the day after Ford had moved into the Mack Avenue plant, the company voted to build its own plant on a 3-acre site at the corner of Piquette Street and Beaubien Avenue. The 402-foot-by-56-foot, three-story Piquette plant was ready in the summer of 1904. The first floor contained offices, a machine shop, an electrical department, a testing area, and a shipping room. The second floor housed another machine shop, plus designing and drafting areas. Painting and final assembly occupied the top floor. By 1905 Ford was building 25 cars a day and employed 300 workers at the Piquette factory. Six years later, in 1911, the Piquette building was sold to Studebaker, which used it for several decades until consolidating operations in South Bend, Indiana. The building is currently used as a warehouse.

Sequencing

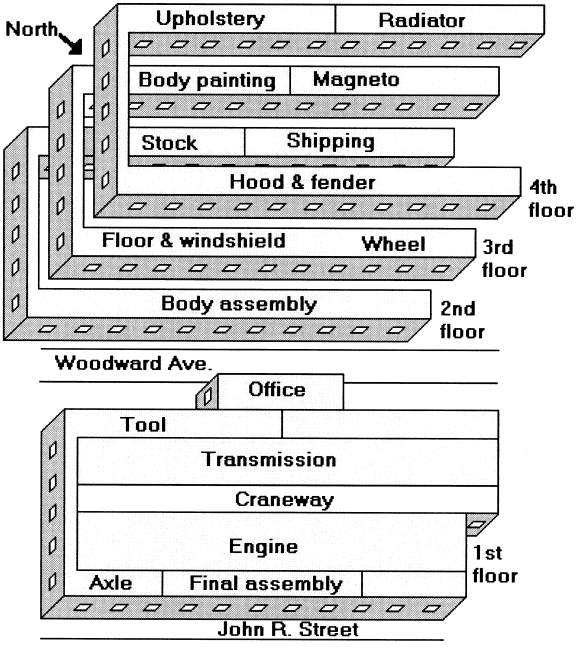
Manufacturers could build vehicles faster and cheaper if they arranged machinery in a logical sequence. Traditionally, machines of one type, such as milling machines, were grouped in one location, and all machining work of a given character was brought there. This arrangement wasted time and effort as workers carried materials around the plant in search of appropriate tools. Motor vehicle manufacturers were the first to place a machine where it was needed to turn out a particular part, even if identical machines were found at more than one location in the factory. This arrangement minimized the need to carry materials around the plant.[12]

Ford pioneered logical sequencing of machinery at the Piquette plant. Heavy equipment was placed on the first floor to make engine blocks, cyl-

inders, crankcase, and crankshaft. Lighter machinery for production of other components was located on the second floor. Ford's chief tool designer Oscar C. Bornholdt recalled arranging machines in "such sequence that there would be an even production throughout the entire process of production, that is, one type of machine would produce exactly the number of parts necessary for 100% production by the next type of machine, the production of all being so synchronized that there was no excess or shortages anywhere." Parts were stockpiled at logical places, "to save the handling of materials in between the machines, which involved two operations." In the words of Bornholdt, logical sequencing avoided "a lot of handling and trucking and saved lots of floor space. . . . Under this method of operation the company did not have to pile up parts between machines in the aisles, and it also was able to reduce its inventory greatly." As Bornholdt put it, "the purpose was to save the third man." The machines were placed unusually close together so that operators could pick up materials with the least possible physical effort. Workers were packed in so closely that "there was no chance of parts even falling off the bench." According to Bornholdt, Ford was the only carmaker following this factory practice at that time. He stated that he "had gone through several of the factories in Detroit and knew this to be the case. The other automobile manufacturers did not have a production big enough to use machines of the type used by Ford."[13]

When Ford planned Highland Park to replace the overcrowded Piquette plant, logical sequencing was included from the beginning. The Highland Park complex included a large, four-story, U-shaped building that faced the street. Two parallel one-story, 800-foot structures inside the U housed the machine shop. A power plant and main office fronted on Woodward Avenue, and a foundry sat on the northeast side of the property (Fig. 1.4). Two parallel six-story buildings, 850 feet by 60 feet, were added in 1914 along Manchester Avenue, primarily for foundry and body work. Running the length of the 800 feet between the two machine shop areas was a 30-foot-wide craneway, covered by a skylight.

Engines, transmissions, and other powertrain components were made and attached to the chassis on the ground floor of the main U-shaped building, a logical location because making these parts required a lot of heavy machinery. Bodies and some chassis components were made on upper floors of the main building. Raw materials, such as steel sheets for fenders, cotton for seats, and glass for windshields, were hoisted by hydraulic lifts as near as possible to the roof, and the work passed down dur-



1.4. Ford Motor Company, Highland Park final-assembly plant layout, 1914. The chassis was made on the first floor, the body on the upper three floors. (Adapted from Arnold and Faurote, *Ford Methods and the Ford Shops*)

ing the manufacturing process along chutes, conveyors, and tubes, until finished components reached the ground floor.

The cylinder block, transmission housings, and other iron and steel parts were cast in the foundry, "a grim building that was regarded as the least successful" element of the complex.[14] The Model T four-cylinder motor, innovatively cast in a single block, weighed 101 pounds. An overhead monorail, resembling a ski lift, carried the castings to the machine shop, where they were milled, drilled, and shaped into final components, such as cylinders, pistons, gears, and rings. Most of the engine-related components, such as cylinder heads, pistons, and differentials, were machined on the eastern side of the machine shop, while other powertrain components, such as transmissions, axles, crankshafts, and camshafts, were machined on the western side of the craneway. The engine and transmission were assembled in the southeastern corner of the machine shop, the front and rear axles in the southeastern corner of the first floor of the main building.

The final-assembly line for the chassis ran along the eastern, or John R

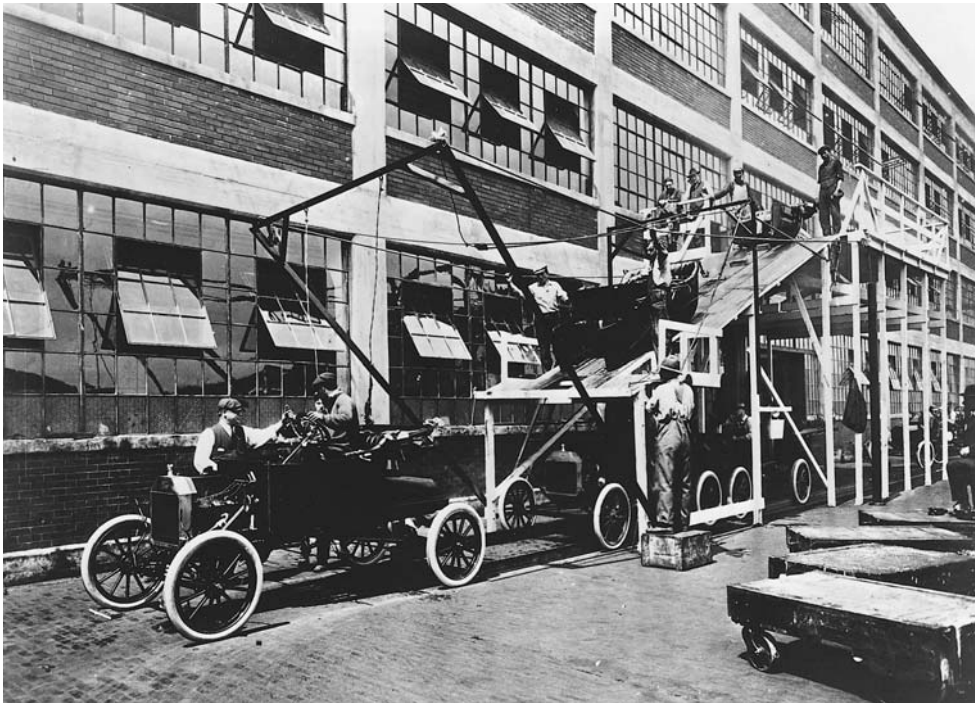
Street, side of the first floor of the main building. At first, the front and rear axles were laid on the floor and attached, along with springs, to the chassis frame. Next the wheels were placed on the axles, followed by the gasoline tank, engine, dash, steering column, and other powertrain components. Chassis components not made in the machine shop were moved by crane from the upper stories of the main building. The radiator was assembled on the Woodward Avenue side of the fourth floor, the magneto on the Woodward Avenue side of the third floor, and the dash on the Manchester Avenue side of the third floor.

The chassis was driven from the assembly line outside onto a track in John R Street. Originally, workers tested the cars by driving them up and down John R Street until they were satisfied. The street was congested with cars moving in no regular sequence, and drivers had too much discretion in determining the amount of time to spend with each vehicle.

While the chassis components were made and put together at ground level, the body was being constructed on the upper floors of the main building. The fourth floor, on the John R Street side, housed departments for finishing large metal components, such as fenders and hoods, stamped from steel sheets. During the 1920s, when steel became the most important component in automobiles, steel stamping took up a lot of space in final-assembly plants, but when Highland Park was laid out, bodies were still made mostly of wood. Also on the fourth floor, on the Woodward Avenue side, was the upholstery department, where the seats and cushions were made.

On the third floor, on the John R Street side, floorboards, windshields, and lights were made. The wooden passenger cabs, which in 1914 resembled bathtubs, were brought for painting and trimming to the Woodward Avenue side of the third floor. When dry, the cabs were lowered to the second floor, where the body components were attached. Completed bodies were placed on skids and slid to an outside wooden platform above the rear-axle inspection station of the chassis line in John R Street.[15]

The most dramatic and widely photographed feature of the assembly process was the final step, which took place outside in John R Street. There the body slid from the platform down a chute and was attached to the chassis (Fig. 1.5). Some of the bodies and chassis were crated unassembled for shipment. Assembled or unassembled, cars were placed in railway cars for immediate shipping; Highland Park had no parking space for storing its products, and in any event all had been sold before they were manufactured. Other than moving inside, the "body drop" changed little in the half-century after Highland Park was built (Fig. 1.6).



1.5. Ford Motor Company, Highland Park final-assembly plant, body drop, c. 1914. The body, which had been finished on the second floor, was slid down the ramp and attached to the chassis, which had been made on the first floor. (From the collections of Henry Ford Museum & Greenfield Village)

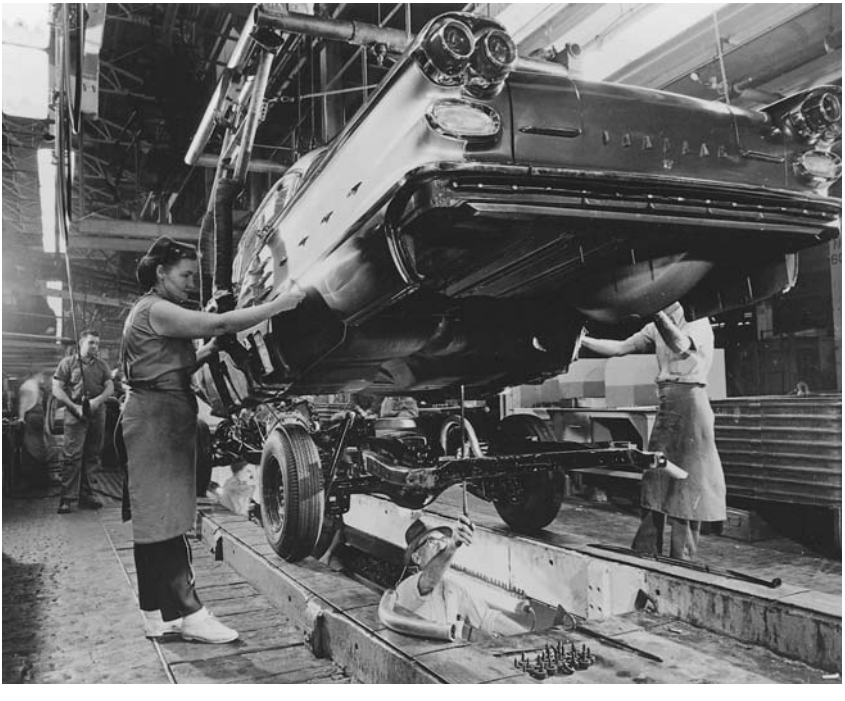
The Moving Assembly Line

Ford installed the first moving line at Highland Park on or about May 1, 1913, to assemble magnetos. The magneto was one of Henry Ford's inventions that helped make the Model T practical. To supply current for the ignition and lights, most vehicles have always used dry batteries, but early batteries were not as light, cheap, or reliable as contemporary versions. Ford's alternative was to attach to the flywheel sixteen separately charged magnets that gave off a series of sparks every time the flywheel turned.

Ford divided magneto assembly into twenty-nine operations and placed a man along a moving belt to perform each of those operations. The 29 men were able to turn out 132 magnetos per hour—1,188 magnetos in a 9-hour day—the equivalent of each worker building a magneto in 13 minutes, 10 seconds. Before the development of the moving line, an individual

skilled worker used to take about 20 minutes to collect the needed parts and assemble a complete magneto.

Experiments with the magneto line over the next year achieved further time savings. The line was raised from 27 inches to 35 inches above the floor so that workers could stand upright. A chain-driven high line, installed on or about March 1, 1914, enabled 18 men to assemble 1,175 magnetos in 8 hours, the equivalent of each worker building one in just over 7 minutes. The initial chain speed of 60 inches per minute proved too fast for the workers, the second speed of 18 inches too slow, the third speed of 44 inches suitable. Once the moving line became familiar to the workers, four men were removed, and the remaining 14 assembled 1,335 magnetos in an 8-hour day, the equivalent of each worker building one in 5 minutes, only one-fourth the time needed by skilled workers at stationary positions.[16]



1.6. General Motors, Pontiac, Michigan, final-assembly plant, body drop, 1958. The operation was inside, and power assists rather than gravity moved the body, but the procedure for dropping the body on the chassis of a 1958 Pontiac had changed little since Ford's Highland Park plant was organized a half-century earlier. (National Automotive History Collection, Detroit Public Library)

The second adaptation of the moving line was to assemble motors, which had been made by four or five men working at benches. Construction of the line began in spring 1913 but was suspended after one day when a worker was injured. Henry Ford reportedly "ordered them to stop because he was afraid that the plan would result in injury to the workmen as a result of the motors falling."[17]

Once the motor assembly line was finally completed in November 1913, 1,000 motors could be assembled by 472 workers in an 8-hour day, the equivalent of each worker building one in 226 minutes. In comparison, at stationary positions 1,000 motors required 1,100 men working a 9-hour day, the equivalent of each worker building one in 594 minutes.

The most dramatic application of the moving line was for final assembly. Credit for inventing the moving assembly line was claimed by several Ford leaders: Charles E. Sorensen, C. Harold Wills, Clarence W. Avery, and Henry Ford himself.[18] Sorensen, assistant superintendent at Piquette, conducted experiments with moving assembly lines on several Sundays during the summer of 1908. He pulled a vehicle frame on skids slowly down a long row of parts and materials placed according to the order in which they were required. Sorensen claimed that Henry Ford watched the experiments "skeptical but interested." A native of Denmark who joined Ford in 1905 as assistant pattern-maker, Sorensen later became chief of production at Highland Park and then the Rouge plant before resigning in 1944.

C. Harold Wills, then Ford's chief engineering assistant, was thought to have had the moving assembly line in mind when the layout for Highland Park was being planned. Clarence Avery, Sorensen's assistant at Highland Park and later Ford's chief development engineer, "was known as pushing the assembly line, . . . pretty much the guiding light in working out the sub-assemblies."[19] Before joining Ford in 1912, Avery had been a teacher and later the supervisor of manual training at the Detroit University School where Henry Ford's son Edsel was a pupil. Unlike Henry Ford or the company's other executives, Avery understood mechanical theory, and he was in touch with other theorists, including Frederick W. Taylor, whose influential book *The Principles of Scientific Management* had appeared in 1911. Henry Ford himself, in his 1922 book *My Life and Work,* claimed credit for the idea, and a promotional film subsequently made by the company reinforced that claim.

Before the installation of a moving line—at Ford's Piquette plant, for example—engines, frames, and bodies built elsewhere in Detroit were set on wooden horses at designated spots, where a team of workers assembled

the vehicles. Several teams assembled cars at the same time at various points within the plant. Painted bodies were rolled to assembly points in wooden frames on casters and hoisted onto chassis by crane. In 1909, the last full year at the Piquette plant, Ford produced 13,840 cars this way, a rate of 7.5 per hour.

At Highland Park, Ford increased production to 20,255 in 1910, 55,788 in 1911, and 89,455 in 1912 by setting up more work stations in the larger building, improving the sequencing of the work, using more machine tools and standardized parts, and designing a car that was easier to build. Ford could assemble 100 chassis simultaneously at fixed locations, with 50 stations along each of two 600-foot lines. In Ford's most productive month so far, August 1913, 330 men (250 assemblers and 80 component carriers) working 9 hours per day for 26 days assembled 6,182 chassis, the equivalent of 12 hours, 28 minutes per worker per chassis. This was the highest efficiency any vehicle manufacturer achieved using stationary work positions. After installation of the moving assembly line a year later, Ford reduced chassis assembly time by 88 percent, to 1 hour, 33 minutes per worker.

The moving final-assembly line was introduced in a series of trial-and-error experiments in late 1913 and early 1914. On an undocumented day in August or September 1913, six final-assembly workers attached a rope and windlass traction to a chassis, and pulled it slowly past components that had been placed alongside in logical sequence. That first experiment reduced chassis-assembling time to the equivalent of 5 hours, 50 minutes per worker.

Encouraged by the experiment, Ford engineers installed a 150-foot line where the chassis could be pushed along by hand past supplies of each component. Frames were brought into the plant and lifted onto two sawhorses. Workers installed the front and rear axles, then attached the wheels to the axles. The sawhorses were removed, leaving the frame standing on its wheels. The chassis was pushed by hand to the next operation.

On October 7, 1913, 140 workers assembled 435 chassis during a 9-hour day, the equivalent of each worker taking 2 hours, 57 minutes per chassis. Lengthening the assembly line to 300 feet, to give each worker more room, yielded further productivity improvements. On December 1, 1913, 177 assemblers working 9 hours completed 606 chassis—2 hours, 38 minutes of workers' time per chassis. A second line was added that month, two more in January 1914.

On January 14, 1914, one of the lines was driven by an endless chain instead of the cars being pushed along by hand. Wheels stocked on a balcony

were delivered to the assembly line by gravity drop and attached to the axles early in the process. A single track was installed along one side of the line to guide the chassis being pulled by the chain. The right wheels were set in the track, while the left wheels rolled on the floor; the rear wheels were slung in three-wheeled cradles or carriers.

With the wheels attached, the chassis was pulled to the next station, where the cylinder-type fuel tank lowered from the balcony by gravity drop was attached under the front seat. Motors were delivered to the final-assembly line in four-wheeled trucks from the motor dress-up line and dropped onto the chassis using hand-operated block and tackle. The dashboard and steering wheel, lowered to the line from the balcony by gravity, were attached to the chassis separately at first but soon assembled as a unit. Next came the radiator, again lowered from the balcony. At the end of the line, the car was started and driven outside for a road test.

Ford constructed a line of rails, called a high line, 26 3/4 inches above the shop floor on February 27, 1914. The chassis slid on its axles, pulled by an endless chain, and the wheels were installed near the end of the line instead of early in the process. Two other chain-driven high lines were soon built, each 24 1/2 inches high, flanking the higher one. Taller men were assigned to the higher line, shorter men to the two lower lines. Eliminating the need for workers to stoop increased efficiency and reduced their fatigue. On April 30, 1914, the three high lines produced 1,212 chassis in 8 hours, or 1 hour, 33 minutes of a worker's time per assembly.

Other U.S. manufacturers quickly emulated Ford's moving assembly line. Maxwell installed an 800-foot track in 1916 that was capable of handling 100 cars at a time and assembling 250 cars a day. Dodge, Hudson, Packard, and Saxon also adopted conveyor belts or chains and overhead monorail carriers by 1916. Continuous moving assembly also appeared at Briscoe, Chevrolet, Reo, Studebaker, and Willys-Overland. Other companies soon matched Ford's efficiency; for example, by using conveyors to move materials from inventory to the assembly line, Hudson took only 90 minutes to assemble a car in 1926—one every 30 seconds—and assembled engines faster than Ford.[20]

No other manufacturer, however, emulated Ford in passing along to the public the financial benefits of the moving assembly line and thereby stimulating universal demand for motor vehicles. The Ford Motor Company cleared a net income of $27 million in 1913 on sales of $89 million. Shareholders received $11 million in dividends. The public shared in the profits through lower prices—the base Model T runabout sold for $440 in 1914,

compared to $500 in 1913 and $525 in 1912—yet lower prices generated even more revenues because of much higher sales. The company was already investing much of its net income into new tools, machines, and factories. And Henry Ford himself had no interest in an extravagant style of life.

Most famously, Ford decided in 1914 to pay his workers $5 a day wages, primarily as a way to share the company's profits with them. At a meeting held on New Year's Day, 1914, Ford directors decided as a matter of fairness to increase expenditures on wages by about $10 million during 1914. The magical number of $5 a day came from dividing $10 million first by the number of employees (about 13,000) and then by the number of operating days (about 250, because factories were closed on Sunday and during the winter in those days). Adding this result (about $3) to the prevailing daily wage (about $2) yielded the $5 figure.

With further tinkering of the moving assembly line, the number of man-hours needed to build a Ford car declined from 1,260 in 1912 to 533 in 1915 and 228 in 1923. Ford production increased rapidly every year: 230,788 units in 1914; 394,788 in 1915; 585,388 in 1916; and 824,488 in 1917. Model T production hit an all-time peak of 1.6 million in 1924, and 67,000 workers were employed at Highland Park in 1925. But the plant's days were numbered. When Model T production ceased in 1927, Highland Park closed, and the assembly line itself was moved to Ford's River Rouge complex. Afterward Highland Park was used on and off for production of some parts, and for truck and tractor assembly, but mostly it served for storage. The production methods pioneered at Highland Park outlived the building by more than a half-century.

Henry Ford and Fordism

Long-time workers at Ford and retirees still refer to the company in the possessive, as "Ford's." Although it has been one of the world's largest companies since the 1910s, the Ford Motor Company belonged to one man and reflected his views of industrial organization for nearly a half-century. So if the production methods pioneered at the Ford Motor Company are significant enough to merit the term *Fordism,* the term must also encompass Henry Ford the individual.

Folk Hero

Henry Ford became an instant celebrity in the United States on January 5, 1914, when he announced that he would pay his workers $5 a day, reduce

the work day from nine to eight hours, and hire several thousand additional workers to staff a third shift. By 1914 Americans were familiar with the Ford Motor Company—about one-third of the one-million-plus vehicles on U.S. roads were Fords—but the public knew little about the man behind the firm. Until this time Henry Ford had been well known only within the automotive industry, but after the announcement everything he said or did was headline news around the world.

Americans quickly learned a lot about Henry Ford, and they liked what they heard: "He is perfectly frank, is wholly self-reliant, is extremely affectionate and confiding by nature. . . . [He] listens willingly to others, decides quickly, and of two mechanical devices chooses intuitively that which best suits the desired end, be it of his own suggestion or another's."[21] On the shop floor, Ford "was one of the boys, always ready with a joke or backslap as he moved among the hands."[22]

A lifelong pacifist, Ford sailed to Europe with a group of writers and social reformers in December 1915 to attempt to mediate an end to World War I. The failed mission drew ridicule, but Ford himself was widely respected for at least having made a bold attempt.[23] He was placed on the Republican presidential primary ballot in Michigan in 1916, and he won. But Ford threw his support to reelect the Democratic president Woodrow Wilson, believing that Wilson was taking every possible step to keep the United States out of the European war.

With the United States now at war, President Wilson convinced Ford to run for the U.S. Senate from Michigan in 1918. Seeking to win as a nonpartisan independent, Ford entered both the Democratic and Republican primaries. He won three-quarters of the votes in the Democratic primary, but lost in the Republican primary to Truman H. Newberry, a former secretary of the navy with strong support from party regulars. As Republicans outnumbered Democrats in Michigan by about six to one, and national sentiment was moving toward Republicans in 1918, Ford's prospects of winning the general election were poor. Opposed to spending money on campaigns, Ford ran a low-key race, while Newberry conducted the most expensive Senate campaign in U.S. history up to that point. Emphasizing his support of Wilson's plan for world peace, including the League of Nations, Ford came close, losing to Newberry by about 4,000 votes, out of nearly 500,000 cast.[24]

Newberry's election gave the Republicans a 49–47 majority in the Senate. Had Ford been elected instead, Democrats and Republicans would have held forty-eight seats each, and with the vote of Vice President Mar-

shall, Democrats would have controlled the Senate during its consideration of the Treaty of Versailles. As a senator, Ford would certainly have added a critical vote for the treaty, whereas Newberry voted against it. Thus Henry Ford very nearly changed world history in a very different way than by pioneering mass production. But he would not have been very patient with the complex procedural maneuvers that preceded the Senate votes.

Soon after helping to kill the Treaty of Versailles, Newberry was found guilty in federal court of violating federal and state spending limits to win the election: the limit was $10,000, and he had spent $176,000. The Supreme Court, in a 5–4 decision, reversed the conviction, ruling that Congress had exceeded its authority by imposing spending limits on primary elections, which were regulated by the individual states. The Republican-controlled Senate nearly voted to expel Newberry, and rather than face further humiliation, Newberry finally resigned the seat in 1922. The man elected to fill Newberry's unexpired term was none other than James Couzens, the Ford Motor Company's business manager from 1903 to 1915, and the man given by many people as much credit for the company's early success as Henry Ford himself.

Despite the narrow Senate loss, Ford was at the height of his popularity at this time.[25] "Ford for President" clubs sprang up during the early 1920s to promote the man who had made the automobile affordable for most Americans and had shared his wealth with his workers. A 1923 *Collier's Weekly* poll of more than 5 million men showed Henry Ford leading President Warren Harding by 20 percentage points (60 percent to 40 percent). But after Harding died in office later that year, and Vice President Calvin Coolidge took over, Ford put a stop to the campaign and endorsed Coolidge in 1924.

Ford's mass production revolution was widely admired and emulated in the Soviet Union. Lenin and Trotsky thought of Henry Ford not as a capitalist but as a revolutionary. Soviet workers carried banners praising Ford in parades. Ford's books were translated into Russian, and a long article on *Fordizatsia* appeared in the first edition of the Russian *Bol'shaia Entsiklopedia*. Ford tractors played a key role in improving Soviet agricultural productivity. A delegation of five Ford engineers traveled 7,000 miles across the Soviet Union in 1926, training Soviet technicians in the repair of tractors, cars, and trucks.

Ford rejected Soviet government requests to build a factory there, having determined that it could not be profitable. Instead, Ford signed a contract in 1929 with the Supreme Economic Council of the Soviet Union to

furnish detailed drawings of factory layouts and machinery specifications, to send skilled engineers to the Soviet Union as advisers, and to let Soviet engineers observe operations at Ford plants in the United States. In exchange the Soviet Union bought 72,000 cars and trucks—or their equivalent in parts—over a four-year period, paying 15 percent above factory cost. The Soviet Union built two plants to Ford's mass production specifications: a large integrated factory, the Molotov Works, at Nizhni-Novgorod (renamed Gorky in 1932); and a smaller assembly plant, known as the KIM works, near Moscow.

Autocrat and Despot

Success with mass production and the Model T had given Henry Ford a belief in the absolute infallibility of his judgment. Ford criticized teachers ("a man's real education begins after he has left school"), bankers ("bankers play far too great a part in the conduct of industry"), and lawyers ("lawyers, like bankers, know absolutely nothing about business"). He wanted to kick out all the doctors from the Henry Ford Hospital and replace them with chiropractors ("many physicians seem to regard the sustaining of their own diagnoses as of as great moment as the recovery of the patient"). In turn, it was said of him by Horace Arnold, who described the first moving assembly line, that "he cares nothing for fiction, nothing for poetry, nothing for history and very little for scientific works, but has a strong liking for epigrams, for short sayings which say much and include sharp contrasts." Probably Ford's most famous epigram was "history is more or less bunk."[26]

Ford believed that sugar was dangerous because under a magnifying glass, sugar crystals looked sharp and jagged. He found proof of reincarnation in the observation that when the automobile was new, chickens had often been hit by cars, whereas some years later they knew to run for the nearest side of the road. Life insurance was bad, because it made people hang on to life. Women caused men to take to crime. Ford liked gamblers because they were good sources of information. He had "no patience with professional charity or with any sort of commercialized humanitarianism. . . . Professional charity is not only cold but it hurts more than it helps. It degrades the recipients and drugs their self-respect." Ford's alternative to charity was work.[27]

Most of the Ford Motor Company's talented executives departed during the late 1910s and early 1920s, including most of those who had been instrumental in the company's early success. Thereafter Henry Ford be-

came a despot who wielded absolute, arbitrary authority over his company.

James Couzens resigned in 1915 over Henry Ford's unwillingness to support the Allies' position before U.S. entry into World War I. Couzens was the Ford Motor Company's first manager, responsible for organizing marketing, advertising, bookkeeping, finance, and other management functions, while Henry Ford ran the production side. Couzens had a great organizational ability and commercial sense, and deserved as much credit as Ford himself for the company's achievements, including the $5 daily wage and the moving assembly line. Couzens was elected mayor of Detroit in 1919 and served three terms in the U.S. Senate before his death in 1936.

Norval Hawkins, who had previously been an accountant with Ford's auditing firm, was removed as the Ford Motor Company's first sales manager in 1918. "Perhaps the greatest salesman that the world ever knew," in the estimation of Detroit attorney Arthur Lacey, Hawkins originated many of the marketing ideas that stimulated the rapid growth in sales of the Model T. After leaving Ford he worked at General Motors for three years as general consultant to the executive committee for advertising, sales, and service.

Among those departing in 1919 was John R. Lee, first head of the Ford Motor Company's Sociological Department, established in 1913 to check on the living conditions and personal lives of Ford workers. Sociological Department personnel visited the home of every Ford employee to determine the stability of the household, cleanliness of the home, wholesomeness of the diet, the language spoken at home, and personal habits, such as church attendance, gambling, and alcohol consumption. Thousands of workers living in substandard housing were relocated to better units, and non-English speakers were enrolled in Ford's English School. Also departing in 1919 was C. Harold Wills, who had played a major role in the design of every Ford car from the first Model A in 1903 to the Model T. William S. Knudsen, who had been responsible for laying out Ford factories around the country, resigned in 1921 following a dispute over control of Ford's European operations. Knudsen joined General Motors in 1922, rising within months to be president of Chevrolet and in 1937 president of GM. Knudsen adopted many of Ford's ideas to help Chevrolet pass Ford in sales in the late 1920s. He left General Motors in 1940 to run the U.S. Office of War Production.

Ernest Kanzler, married to the sister of Edsel Ford's wife, left the company in 1926 after writing a six-page memo to Henry Ford about the need

to replace the Model T with a more modern car. Clarence W. Avery, who had been the guiding light in setting up Ford's first moving assembly line, and Charles Hartner, who had charge of all machine operations, both left when the Highland Park plant closed in 1927.

After that time Henry Ford's eccentric pronouncements on subjects about which he knew nothing became more sinister. He blamed World War I on a conspiracy of "a group of men with vast powers of control, that prefers to remain unknown." He "lived in continuous fear of a conspiracy to destroy him, his family, and his company. Its elements, interlocked in his mind, consisted of Wall St., the Jews, the Communists, the duPonts, Roosevelt, and the labor unions."[28]

Ford published a string of about ninety articles during the 1920s in the *Dearborn Independent*, a weekly newspaper he owned, in which he claimed a secret international Jewish organization was bent on disrupting the Christian way of life by gaining control of world politics, commerce, and finance through war, revolt, and disorder. According to Ford's *Independent* articles, Jewish financial interests manipulated Wall Street, distributed illegal alcohol, raised rents and women's skirt hems, and produced cheap Hollywood movies, vulgar Broadway shows, and jazz.[29]

Henry Ford admired the enterprise, orderliness, and industrial skill of the German Third Reich. On his seventy-fifth birthday, July 30, 1938, one month before the Munich pact, Ford accepted the Grand Cross of the German Eagle from Fritz Hailer, the German vice consul, in front of a cheering crowd in Dearborn. Said Adolf Hitler about Henry Ford: "I am a great admirer of his. I shall do my best to put his theories into practice in Germany."[30]

During the 1930s Henry Ford turned over responsibility for running his mass production empire to Harry Bennett, a boxer with connections to organized crime. Bennett's wildly misnamed Service Department—staffed by several thousand thugs—beat up workers suspected of union sympathies, prevented them from talking to each other, and monitored their trips to the bathroom. Bennett's power exceeded even that of Henry Ford's son Edsel, who had the title of company president. Ford believed that his son was not tough enough to stand up to competitors, union organizers, and government regulators, whereas Bennett got things done in a hurry, especially disagreeable tasks, such as firing union sympathizers. When forty-nine-year-old Edsel died in 1943 of complications from stomach ulcers and cancer, the old man returned as president at age eighty, but in reality Bennett's takeover of the company was by then nearly complete.

Enough Americans were fed up with Henry Ford's ignorant, bigoted pronouncements and brutal treatment of workers that they refused to buy Ford cars. Ford's market share fell from 51 percent in 1924 to 20 percent in 1942; it was in third place behind General Motors and Chrysler in 1942, when production was halted three months after the Japanese attack on Pearl Harbor.

The U.S. government considered taking over direct control of the Ford Motor Company during World War II, alarmed that one of the nation's largest industries, destined for a critical role in war production, was mismanaged and run by gangsters. As a last resort before nationalizing the company, the secretary of the navy ordered Edsel's oldest son, twenty-six-year-old Henry Ford II, discharged from the service and brought home from the Pacific. By threatening to sell their company stock, the elder Henry's wife Clara and Edsel's widow Eleanor finally forced the old man in 1945 to turn over the presidency of the company to young Henry. Minutes after becoming president, Henry II, armed with a gun, walked into Harry Bennett's office, and fired him from the company (though he did not fire *at* him). Two years later, Henry Ford died.[31]

Fordism, as personified by Henry Ford, represented a highly sympathetic economic system early in the twentieth century. By revolutionizing industrial production, Fordism made the automobile affordable for most American families and brought decent wages to workers in the automotive industry. At mid-century, Fordism was still personified by Henry Ford, although the concept had by then taken on more sinister meanings, such as inhuman working conditions, harsh suppression of workers' rights, and autocracy.[32] By the end of the century, with Henry Ford long dead, the personification of Fordism had faded, and the entire notion of interpreting economic change through the personality of a company owner had come to seem trivial to many. Toyota president Eiji Toyoda made a much less compelling symbol of post-Fordism. But ignoring Henry Ford the person would leave a study of Fordism incomplete. And Henry Ford's great-grandson William Clay Ford Jr. became chairman of Ford Motor Company in 1999.

2 . . . To Lean Production

Before you can make things flexibly you must first make them simple.
The Economist, July 29, 1989

IN THE SAME year when Lindbergh flew nonstop alone across the Atlantic and Al Jolson sang in the first talking movie, *The Jazz Singer,* the public unveiling of the Ford Motor Company's latest Model A car caused an even greater public sensation than either of these notable events. Within thirty-six hours of its unveiling on December 2, 1927, the new Ford car had been inspected by 10 million Americans. A million people jammed New York's Broadway outside the Ford showroom seeking a glimpse of the new car, which was duly moved into nearby Madison Square Garden to accommodate the crowd. In Detroit, 100,000 people crowded into Ford showrooms the first day, and in other cities police had to control crowds. Within two weeks, 400,000 orders for the new car had been placed.

The Model A's performance and styling were not especially remarkable, but its development process was. A quarter-century before Japanese producers began to tinker with elements of lean production—and a half-century before the term *lean production* reached the United States—Henry Ford placed the Model A in showrooms less than sixteen months after issuing an oral order to begin designing it, in August 1926. Sketches were completed in December 1926, the first body and chassis blueprints in January 1927, a prototype of the new model in March, and a completed model in August. The Model T assembly line at the Rouge was shut down on May 31, tools and dies to make the 5,580 parts were created in September and October, Henry Ford stamped by hand the serial number of the first Model A engine on October 20, and the Rouge assembly line restarted on November 1.

U.S. manufacturers struggled to convert from mass production to lean production in the late twentieth century, but five decades earlier Henry

Ford had developed the Model A faster and cheaper than later lean producers. U.S. car makers took sixty months to develop new vehicles during the 1980s, and the vaunted Japanese lean production system took forty-six months. Caring little for accounting, Henry Ford had no idea how much was spent on developing the Model A; he guessed $100 million, though others calculated the total cost at $250 million, the equivalent of about $2 billion in 2000.[1] The Model A was a bargain compared to the $6 billion that Ford Motor Company spent to develop a compact car sold during the 1990s in most of the world as the Mondeo and in North America with limited success as the Ford Contour and Mercury Mystique.

Arbitrary decision making and unscientific procedures put the Model A on the street quickly and cheaply. Henry Ford assigned a trusted assistant to develop each of the major systems, such as transmission, engine, and body, and he made final decisions about the systems by concluding, "Oh, that looks all right," or "Scrap it." The prototype was tested by pushing it beyond its rated capacity and standard. Instead of detailed reports, Ray Dahlinger, Ford's tester, typically commented either, "It is God damn good," or "The car's no damn good."

Comfortable with the mass production paradigm inherited from Ford, North American and European vehicle producers took a decade to diagnose what went wrong beginning in the 1970s, another decade to structure responses, and yet another decade to implement changes. The mass production paradigm had to be replaced with lean or flexible production, manufacturers were told. Empirical evidence proved that lean production produced higher quality vehicles more efficiently than traditional mass production.

After breathlessly chasing lean production for a quarter-century, North American and European producers learned that the paradigm was not merely elusive, but transitory. And Japanese competitors learned that resting on their lean production successes would not keep them competitive in future. Instead, optimum-lean or post-lean production was the order of the day. In key respects, optimum-lean production represented a return to mass production principles and a rejection if not compromise of key elements of lean production.

Three-quarters of a century after Ford developed the Model A in sixteen months for the equivalent of $2 billion, optimum-lean production helped manufacturers finally match Ford's feat. In the estimation of automotive historians Allan Nevins and Frank Ernest Hill, "by any standards of measurement, this rebirth of the Ford automobile [in 1927] must be ac-

counted one of the most striking achievements of twentieth century industrial history."[2]

The Book That Changed the Machine

Most North American final-assembly plants offer public tours. Even a casual visitor on a public tour in 2000 could see obvious differences between the North American assembly plants operated by U.S. companies, such as General Motors and Ford, and those operated by Japanese companies, such as Honda and Toyota. At Toyota's assembly plant in Georgetown, Kentucky, visitors were driven along a fixed route in an open-air tram, like those found at resorts or amusement parks. The tour guide offered a set commentary easily heard through speakers in the tram and deflected probing questions with superficial answers. Interaction with the workers was impossible for the visitors seated in the moving tram.

At a GM plant, in contrast, visitors went about on foot, following a guide who modified the itinerary on the spot to dodge forklifts, detour around pallets piled with parts, and avoid other tour groups. Visitors had to stand close to the guide to hear the commentary above the noise, but if they listened, they would be rewarded with frank comments about broken machinery and inefficient procedures. Visitors were asked to stay in a tight group, but especially curious visitors would lag behind to chat with line workers, or at least to observe cigarettes dangling from their lips, discarded snack food wrappers on the floor, and half-eaten meals and half-read newspapers spread on picnic tables. In the Toyota plant the floor looked so clean you could eat off it, while in a GM plant the floor looked as though leftovers from lunch were never removed from it.

U.S. car makers through the 1980s failed to accept that differences between mass production and lean production assembly plants—visible to even the most uninformed visitors—were significant. The smoking gun that irrevocably convinced even the last holdouts came from a $5 million, five-year study begun in 1986 by the Massachusetts Institute of Technology (MIT) International Motor Vehicle Program (IMVP), paid for by U.S. and European car makers and government agencies in several North American and European countries. The resulting book, published in 1990, is probably the most influential auto industry study ever published.

Coauthored by IMVP research director James P. Womack, European director Daniel T. Jones, and project director Daniel Roos, the book missed the mark only with its misleading title, *The Machine That Changed the World,*

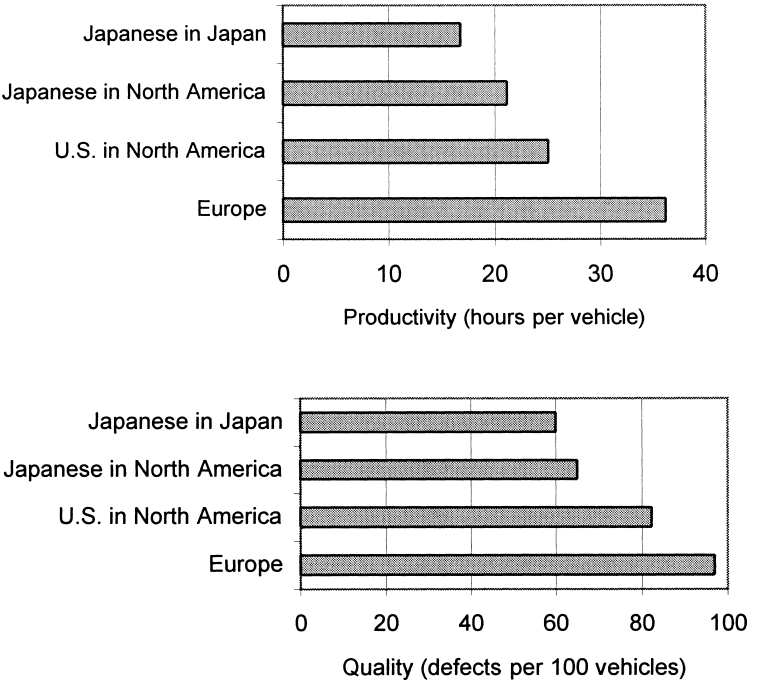
which seemed to promise some sort of broad treatise on culture and society. On hindsight, a more appropriate title would have been "The Book That Changed the Machine," or "The Book That Changed the Auto World." *The Machine That Changed the World* shocked skeptical U.S. and European car makers into admitting that the quality gap existed; in addition, and more important, it convincingly explained the causes of the quality gap. The upheavals of the 1990s in the U.S. auto industry—vertical disintegration, reskilling labor, and especially flexible production—followed the diagnosis and prescription set out by the IMVP study. Womack and Jones followed up the original study in 1996 with *Lean Thinking,* which further explored the elements of lean production.

The term *lean production* was coined by IMVP team member John Krafcik. As the term implies, lean production used less of everything than mass production—less labor, less manufacturing space, less investment in tools, fewer engineering hours to develop new products in less time, less inventory, and fewer defects—all resulting in a greater variety and more frequent changes of products.

Toyota was widely credited with the introduction of lean or flexible production, motivated by constraints in adopting U.S.–style mass production. The story is that in 1950 Eiji Toyoda made a pilgrimage to the great temple of mass production, Ford's Rouge complex, and returned home to Japan wanting to build the same sort of complex. But he ran into fatal limitations, including a lack of capital to purchase expensive machinery from the United States and a domestic market too small to justify producing a large volume of identical vehicles. Out of necessity, Toyota and the other Japanese companies looked for more flexible alternatives to the Rouge model.

The initial reaction of U.S. car makers to the IMVP study was negative. According to Womack, "I thought it was going to be dismissed as one more Toyota book that nobody wanted to read."[3] But the IMVP project did convince U.S. and European car makers to embrace lean production.

The IMVP's most significant evidence supporting the benefits of flexible production was buried in the first two lines of a table labeled "Figure 4.7." The table summarized the performance of four sets of final-assembly plants—Japanese plants located in Japan, Japanese-managed plants in North America, U.S.–owned plants in North America, and European plants (owned by either U.S. or European companies)—according to the two most important indicators that all motor vehicle manufacturers used: productivity and quality (Fig. 2.1).



2.1. Productivity (top) and quality (bottom) of final-assembly plants in Japan, North America, and Europe, late 1980s. Productivity was measured as the average number of hours needed to assemble a vehicle; quality was measured as average defects per 100 vehicles. (Adapted from Womack, Jones, and Roos, *The Machine That Changed the World,* Fig. 4.7)

Comparing Productivity

The IMVP measured productivity principally by the number of hours needed for assembly. Because all assembly plants performed roughly the same three operations—welding the body, painting the body, and attaching components to the body—the time needed from initial welding to final drive-away of completed vehicles was the industry's best measure for comparing relative efficiency.

Mass production used narrowly skilled professionals to design products made by unskilled workers tending expensive single-purpose machines that churned out high volumes of standardized products, which then piled up in inventory until they were needed. The result was lower costs for con-

sumers, but the saving was achieved at the expense of variety and by means of work methods that most employees found boring and dispiriting.

Lean production more closely resembled nineteenth-century craft production than twentieth-century mass production. Craft production used highly skilled workers and simple, versatile tools to make exactly what consumers wanted, one at a time. Lean production employed teams of multiskilled workers and highly flexible automated machines to produce a wide variety of products. The IMVP found that lean producers needed much less time than mass producers for final-assembly operations: 17 hours for plants in Japan, 21 hours for Japanese-managed North American plants, 25 hours at U.S.–owned North American plants, and 36 hours at European plants.

Annual studies released by Harbour and Associates, Inc. during the 1990s showed that the productivity gap continued a decade after publication of *The Machine That Changed the World*. The Harbour firm, founded by James Harbour, former director of corporate manufacturing engineering at Chrysler, compared the number of labor hours needed to produce vehicles at final-assembly plants operated by the six largest producers in North America: Chrysler (later DaimlerChrysler, abbreviated as DCX), Ford, GM, Honda, Nissan (later Renault), and Toyota. The two Japanese-owned companies, Honda and Toyota, needed about 21 hours to assemble a vehicle, Ford about 24 hours, and GM about 27 hours. The two European-owned firms were at the extremes: Nissan (Japanese-owned until 2000) needed only 19 hours, and DCX (American-owned until 1998) 30 hours.

The productivity gap between U.S.–owned and Japanese-owned factories in North America translated into $1,926 per vehicle, according to a study conducted by the Economic Strategy Institute in the early 1990s.[4] Three factors contributed to the productivity gap: labor costs (accounting for $821 of the gap, including $316 in higher wages and $505 in higher health care costs); capital costs ($985 of the gap, including $540 in additional machinery and equipment, and $445 in excessive and underused plant capacity); and less efficient organization of comparable tasks and procedures ($120 of the gap).

According to the Harbour study, labor costs contributed to the productivity gap primarily because U.S. companies used unscheduled overtime to assemble vehicles. Ford had lower labor costs than DCX and GM because it had more scheduled overtime to build more vehicles. U.S. companies also needed more hours because they built more trucks, which took longer to assemble. Ford's Atlanta plant, which assembled Taurus cars, took only

17 hours per vehicle in 2000, the most efficient operation of any company in North America. Ford's overall efficiency was lower because of its truck plants.

Harbour provocatively calculated each company's number of "excess" workers compared to the most efficient competitor. By this measure, compared to Japanese-owned companies, GM employed about 45,000 "excess" workers in the 1990s, DCX about 23,000, and Ford about 14,000. Harbour calculated the resulting "labor cost penalty" per vehicle to be about $600 at Ford and $1,000 at DCX and GM.

Savings in capital expenditures made by Japanese plants were documented in *The Machine That Changed the World.* For example, every manufacturer needs stamping presses, in which matched upper and lower dies, pushed together under enormous pressure, shape flat sheets of steel into hoods, doors, and other components. *The Machine That Changed the World* found that Japanese plants had automated metal-stamping presses with lightweight dies that could be changed in minutes, whereas U.S. plants had large presses fitted with heavy dies that took a specialist a full day to change, while machine operators stood by idly.

To avoid the lengthy idle time for changing dies, U.S. plants traditionally dedicated a different set of presses to stamp a large batch of each part. "Because the machinery costs so much and is so intolerant of disruption, the mass-producer adds many buffers—extra supplies, extra workers, and extra space—to assure smooth production."[5] Changing over to a new product costs even more, so the mass-producer keeps standard designs in production for as long as possible.

For Japanese manufacturers back in the 1950s, allocating a press to just one part was an unattainable luxury: they didn't sell enough cars to justify stamping out millions of identical parts, and they could afford to buy only a few presses. Japanese manufacturers solved the problem by designing lightweight dies and developing techniques for changing dies every few hours (notably rollers that positioned the dies in the presses). They discovered that the unit costs actually declined if they made small batches. Moreover, idle line workers, rather than high-priced specialists, could change the dies, inventory costs were reduced, and mistakes in stamping showed up more quickly, reducing the waste of repairing or discarding defective parts.

General Motors learned in the 1980s that spending lavishly on capital improvements did not result in higher productivity. While DCX and Ford adopted low-tech strategies, such as installing more flexible, lightweight,

Japanese-style presses in their plants, GM in the 1980s, under the leadership of Roger Smith, invested $80 billion in automation. The company spent $2.5 billion in 1984 to buy Electronic Data Systems, a computer services firm that could design, program, and manage the automation effort, and it spent $5.2 billion in 1985 to buy Hughes Aircraft. It also established GMF Robotics, a joint venture with the Japanese robot producer Fanuc, Ltd., in 1982 and held a minority interest in Teknowledge, an artificial intelligence firm specializing in expert systems development.

Much of GM's spending on new technology in the 1980s was wasted. At Hamtramck, Michigan, where most of the company's expensive Cadillacs were assembled, the company installed 260 robots to weld and paint cars, 50 automatic guidance vehicles to replace forklift trucks and drivers, and a laser-based measuring system. The plant could produce only thirty cars an hour, and malfunctioning machinery damaged many of the partially assembled vehicles. Robots installed panels, and then workers banged on them to make them fit better.

Instead of introducing advanced technology first, GM should have improved management of existing technology, through changes in work rules, personnel screening, training, participatory management, and efficient inventory management, according to David Cole, director of the Center for Automotive Research at the Environmental Research Institute of Michigan (Cole is the son of a GM president). Continuous improvement in Japanese companies came not from automation, but from people eliminating waste, moving materials more efficiently, and making other incremental changes. When a problem arose, it could be prevented from recurring by installing a simple mechanical fix on the existing line, not by ripping out everything and starting all over.

The Machine That Changed the World concluded that the major cause of the productivity gap was "manufacturability." The world's nineteen largest producers were asked to rank the other eighteen companies according to the ease with which their vehicles could be built. Producers were asked because they routinely obtain competitors' models and tear them apart, down to the individual parts, to see what they can learn about how the parts were put together and how well they were made. The easiest vehicles to build were made by Toyota, followed by Honda. All eighteen competitors ranked Toyota's vehicles among the three easiest to build. Ford was the highest ranking U.S. company, in sixth place, with GM ranked tenth, and Chrysler thirteenth. Mercedes-Benz was ranked eighteenth, and Jaguar last.

A 1989 GM study cited in *The Machine That Changed the World* found a large productivity gap between GM's Fairfax, Kansas, plant, which assembled the Pontiac Grand Prix, and Ford's Taurus assembly plant in Atlanta. Factory practices, such as just-in-time delivery and a cord for workers to stop the line for problems, accounted for 48 percent of the gap, even though the GM plant was more automated than the Ford plant. Another 41 percent of the productivity gap stemmed from the manufacturability of the two vehicle designs. For example, the Taurus's front bumper was put together from 10 parts, that of the Grand Prix from 100. Nine percent of the gap came from higher prices for purchase of components, and 2 percent from processing.[6] Because GM vehicles contained more parts that were harder to put together, its workers needed more time to assemble them and spent more time standing around waiting for machines to run. GM workers weren't lazy, they just could not be as efficient as other workers, given the design of the vehicles they were assembling.

Comparing Quality

The quality goal under mass production was to be "good enough," while under lean production it was to be perfect. Mass-producers set a target of an acceptable number of defects and proclaimed success when the target was achieved. Lean producers can never achieve the goal of perfection, so they settle for a continuous, never-ending process of improvement, called *kaizen* in Japanese.

The Machine That Changed the World measured quality at assembly plants by the number of defects per hundred vehicles detected by dealers or consumers. Because manufacturers know where each of their vehicles was assembled (consumers can look on the driver's door to find that information), complaints can be traced back to place of assembly. Recurring complaints about particular kinds of problems can be pinpointed to specific tasks and even individuals at the assembly plant.

IMVP relied on the Initial Quality Survey conducted in 1989 by J. D. Power and Associates, one of a large number of quality measures generated by that company (see chapter 8, below). In 1989 Japanese companies had an average of 60 defects per 100 vehicles assembled in their plants in Japan and 65 per 100 in their North American plants. North American plants owned by U.S. companies had 82 defects per 100 vehicles, and European plants had 97 per 100.

Stung by the demonstrated gap in quality with Japanese competitors, U.S. and European car makers scrambled to improve. They gave report

cards to their parts suppliers; for example, in the first quarter of 1996, 45 percent of Ford suppliers failed to meet the car maker's quality standards.[7] When individual programs provided only limited gains, car makers got together to impose uniform programs of improvement on all suppliers, known as ISO-9000 and QS-9000.

Under ISO-9000, every factory had to be formally certified as complying with detailed quality standards. A policy manual had to be written, stating the purpose of each plant function, the person responsible for meeting quality standards at each function, what could go wrong, and responses planned to fix problems. In addition, detailed job instructions had to be posted at each work station. "Spot-weld the two pieces where they attach" was an example of insufficient information; instructions had to specify how to administer welds, where to position welds, and how to move the piece along the assembly line.

To develop the policy manual and detailed job instructions, an ISO team had to inspect each job site in the factory and talk with every worker and supervisor. Written guides could be purchased to help streamline the certification process, but factories committed to improvement took advantage of the opportunity to learn what was really happening, eliminate unneeded tasks, and remind employees of the critical importance of quality. ISO-9000 (*iso* is the Greek word for "equal") also had a monitoring system to assure that quality standards were being met. Independent auditors roamed the plant, asking individual workers such questions as "What do you do?" "How do you know what you're supposed to be doing?" and "How do you know whether a part is good or bad?"

U.S. companies carried the certification procedure a step beyond ISO-9000 to QS-9000. Under QS-9000 (*QS* stands for "quality systems"), beginning in 1994 an entire company, and not just an individual plant, could be certified as meeting quality standards. The company had to provide a business statement explaining precisely the requirements of every job, mission of every department, procedures to achieve goals, and measures to monitor work. All companies wishing to supply components to DCX, Ford, or GM had to be certified under QS-9000 by 1997. The three car makers jointly created QS-9000 so that suppliers would not have to undergo an elaborate, yet slightly different certification procedure for each manufacturer. Most Japanese suppliers in North America were also certified.[8]

The car makers themselves emulated the Toyota Production System (TPS), a rulebook of principles and procedures for factory managers and

employees to follow. TPS espoused five basic principles (discussed in more detail in chapter 6, below):

1. Involve the entire organization in seeking continual improvements.
2. Train workers to perform tasks according to standardized procedures.
3. Eliminate waste of all kinds, including waste of motion and space.
4. Empower workers to stop production when quality is threatened.
5. Minimize inventory, and maintain a level production flow.

Procedures included how parts were to be delivered to the assembly line, how employees should move about their jobs, and how problems could be avoided.

The Chrysler Operating System, modeled on TPS, required factory workers and suppliers to look for savings and eliminate waste at all stages of production. The Ford Production System benchmarked its own best practices worldwide and integrated them throughout the company.

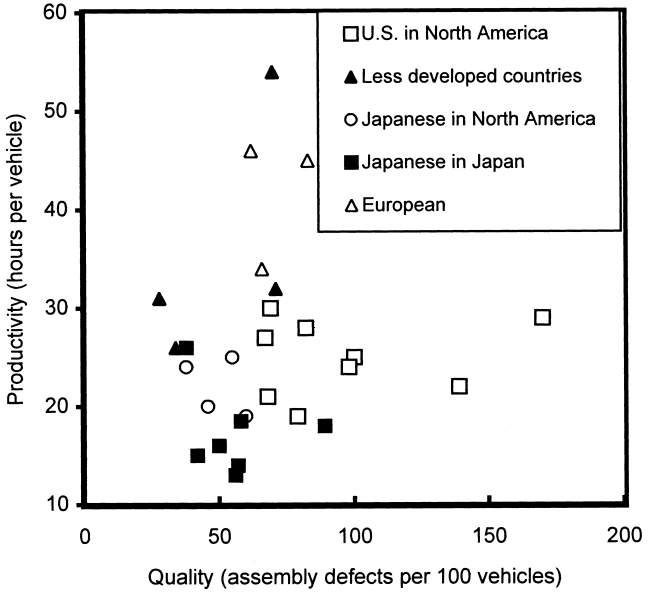
ISO-9000, QS-9000, and production systems helped North American and European manufacturers to narrow the quality gap with Japanese plants—but not to eliminate it. Japanese firms made no secret of their procedures and permitted American automotive executives to tour their factories. For Japanese companies, this openness was simply returning the favor of a previous generation. After all, as Ford vice president David Thusfield, pointed out, "You have to remember that TPS used Henry Ford's original production system as a benchmark."[9]

Trading Off Productivity and Quality

For European and North American companies, *The Machine That Changed the World* reinforced the traditional view that mass production involved a trade-off between productivity and quality. North American manufacturers achieved high productivity at the expense of quality, while European manufacturers sacrificed productivity for high quality. North American mass-producers could always raise productivity—that is, reduce the number of hours needed to build a vehicle—by speeding up the line or by stamping out more rapidly a batch of identical parts. But conventional wisdom dictated that such speed-up methods lowered quality because workers had less time to be careful, and supervisors waved through faulty output to meet production quotas. In contrast, European producers achieved high quality inefficiently. The IMVP found in an unnamed German plant (rumored to be Mercedes-Benz) that "at the end of the assembly line was an enormous rework and rectification area where armies of tech-

nicians in white laboratory jackets labored to bring the finished vehicles up to the company's fabled quality standard. We found that a third of the total effort involved in assembly occurred in this area." One-fifth of the floor space in U.S. and European assembly plants was devoted to rework, while Japanese plants had virtually no rework areas. "In other words," according to the IMVP study, "the German plant was expending more effort to fix the problems it had just created than the Japanese plant required to make a nearly perfect car the first time."[10]

The IMVP depicted the inverse relationship between productivity and quality for American and European manufacturers in a graph, labeled "Figure 4-8" (Fig. 2.2). Each symbol on the graph represents the observed productivity and quality at one assembly plant, with higher quality (lower defect rate) farther to the left along the x-axis and higher productivity (lower assembly time) lower on the y-axis. U.S. assembly plants were arrayed horizontally across the graph, indicating that productivity was relatively constant—about 25 hours per vehicle—while quality ranged from average to poor. European plants were arrayed vertically, indicating that quality was



2.2. Productivity compared to quality of final-assembly plants in Japan, North America, and Europe, late 1980s. (Adapted from Womack, Jones, and Roos, *The Machine That Changed the World,* Fig. 4.8)

relatively constant—about 70 defects per 100 vehicles—while productivity ranged from below-average to poor. The pattern of U.S. and European plants reinforced conventional wisdom in the late 1980s that the Europeans built high-quality vehicles (for example, Mercedes-Benz and BMW) inefficiently, while American manufacturers were turning out relatively low-quality Chevrolets and Fords efficiently. The impact of the graph came from the cluster of Japanese plants in the lower left of the chart, indicating that their productivity was higher than in the North American plants and their quality higher than in the European plants. Thus, the IMVP concluded that the Japanese plants had both the highest productivity and the highest quality, contrary to the conventional wisdom of mass production. Another striking feature of the graph was that the Japanese-managed plants in North America achieved levels of quality and productivity comparable to those of the plants in Japan. Built on so-called greenfield sites (that is, newly constructed in rural areas rather than adapted from older structures in traditional industrial areas), the Japanese "transplants" enjoyed a decade of making clean-slate factory innovations, continually seeking ergonomic improvements, eliminating waste, and ensuring a better flow of materials.[11]

Optimum Lean Production

While U.S. and European companies were struggling to implement lean production during the 1990s, Japanese companies discovered a fatal flaw: lean production did not translate into high profits. Japanese car makers continued to outscore U.S. and European firms on quality and productivity—the two most important benchmarks of lean production—but they recorded a lower level for what was in reality a corporation's true benchmark—profit.

Among the six leading North American car makers during the 1990s, the three U.S.–owned, or formerly U.S.–owned companies—DCX, Ford, and GM—averaged about $700 profit per vehicle, while the three largest Japanese-owned or formerly Japanese-owned firms—Honda, Nissan, and Toyota—averaged about $300 per vehicle. DCX had the highest profits per vehicle of the six companies (about $1,200), followed by Ford (about $900), Toyota (about $800), and Honda (about $600). GM's profits per vehicle lagged at $300, and Nissan lost about $300 per vehicle.

Despite relatively low productivity and quality ratings, DCX recorded the highest profits per vehicle during the 1990s because it could charge

higher prices for its popular truck models, which accounted for two-thirds of its sales. And DCX made relatively few parts, so it could reduce production costs by demanding lower prices from its parts suppliers. In contrast, the situation was desperate at Nissan, which lost money nearly every year during the 1990s before its sale to Renault. Although its assembly plant was consistently ranked the most efficient in North America, and quality was high, sales suffered because its products were not especially distinctive or appealing to consumers.[12]

The Japanese companies had lower profits in part because of higher staff, marketing, distribution, and other administrative costs: Toyota's administrative costs were twice as high as those of GM, the least efficient U.S. company. Wild fluctuations in the exchange rate between the dollar and the yen during the 1990s played havoc with the profits of Japanese companies. During the 1990s, one U.S. dollar was exchanged for as much as 150 yen and as little as 80 yen.

A vehicle designed in Japan to be sold profitably at 2 million yen could be priced in the United States at $20,000 if the exchange rate was 100 yen to the dollar. When the value of the yen fell to 150 per dollar, per unit profits soared when vehicles sold in the United States for $20,000. The same rate of return on investment could be achieved by pricing the vehicle in the United States at only $13,333, but capturing a higher market share through lower prices would be counter-productive in the long run because it would incur the wrath of trade protectionists in the United States. When the yen rose to 80 to the dollar, a $20,000 sticker price lost money. The same rate of return could be maintained only by raising the price in the United States to $25,000, a level that would reduce market share and therefore overall profits. But bloated bureaucracies and fluctuating yen-dollar exchange rates did not address the fundamental problem facing Japanese lean production. Japanese car makers blamed most of their low profits on a failure of lean production that became known as the "Lexus effect."

The "Lexus Effect"

The failure of lean production known as the "Lexus effect" was excessive concern for continuous engineering improvement regardless of impact on cost or design. The term refers to the history of the Lexus: when Toyota introduced Lexus as a luxury nameplate in the 1991 model year, it immediately achieved J. D. Power's highest quality ratings ever. But Toyota's search for continuous improvement created a system in which engineers had the power to overspecify and overcomplicate design standards. For

example, Lexus did not offer a convertible in part because Toyota engineers were required to design a top-opening mechanism that could be activated 1,000 times at -30°C, even though nobody lowers the top at that temperature.

Japanese companies found that with quality already so high, further improvements were harder to find and more expensive to implement. Consumers expected high quality when they bought Japanese vehicles, but did they want that high quality at no matter what price? In 1985 U.S. consumers paid an average of $10,800 for Japanese vehicles, compared to $11,200 for domestic vehicles. A decade later the median price for Japanese vehicles had risen to $25,000, compared to $18,000 for domestic vehicless.

Instead of continuous improvements measured in terms of quality and productivity, Japanese manufacturers set as their principal goal improvements in quality and productivity that yielded cost savings and therefore higher rates of return on investment for shareholders. To achieve cost savings, Japanese companies no longer automatically implemented quality and efficiency improvements without first considering cost-effectiveness. Through a process of triage, defects were classed as those any customer could see, those possibly detected by some customers, and those no customer would detect. The first two types of defects were still prohibited at the start of the twenty-first century, but the third type defects would now be permitted.[13]

At the same time targets for cost savings were set so that profits could be made even when the yen was valued as high as 80 to the dollar. Although Japanese companies did not tie specific profit targets to the exchange rate, under lean production profits were made only when the yen was valued at 100 or more yen to the dollar.[14]

Manufacturers achieved higher profits through optimum lean production in two principal ways: speed and economies of scale. Car makers pronounced adages reminiscent of mass production: speed saves money and large size saves money. As a result, vehicles developed using optimum lean production methods were cheaper and faster to build than those they replaced.

Speed Saves Money

Under optimum lean production, manufacturers tried to save time and therefore money through faster development and assembly of new vehicles than was possible under the continuous improvement paradigm of

lean production. They saved time in two principal steps: development and assembly.

With regard to development, when mass-producers converted to lean production, they reduced the time needed to develop new vehicles by about one year, from about five years to four. The switch from lean production to optimum lean production cut development time more sharply, to less than two years.

With regard to assembly, Japanese car makers using lean production methods averaged about 20 hours to assemble vehicles during the 1980s, compared to 27 hours for North American companies using mass production methods. A decade later North American companies adopting lean production methods reduced assembly time to 18 hours, comparable to the level of Japanese firms using lean production. But Japanese companies by then had moved on to optimum lean production and had cut assembly time to about 10 hours, thereby maintaining a gap in productivity.[15]

Optimum lean production cut development and assembly time by refining lean production in two principal ways, known in the industry as *commonality* and *co-location*. *Commonality* meant that manufacturers designed new models using as many components as possible from older models. *Co-location* was auto industry jargon for a group of people at different locations working simultaneously on a new project through computer linkage.

Commonality Saves Money. Under lean production, Honda's newly designed Accord, introduced in 1990, shared 10 percent of its components with the previous model, introduced in 1986. Under optimum lean production, the 1994 Accord shared 50 percent of its components with the previous model, introduced in 1990, and the 1998 Accord shared 50 percent of its components with the 1994 model. Other Japanese car makers emulated Honda's strategy. What had been a mark of pride—designing an entirely new model from scratch in four years—was replaced by cost-saving demands to cannibalize older models whenever possible and complete the task within two years.

To promote commonality, manufacturers using optimum lean production eliminated one of the most distinctive organizational features of lean production, the platform team. Under lean production a small team was brought together to coordinate development of a platform. Chrysler, for example, in the 1990s had a separate platform team for each of its three

main sizes of cars. Team members came from functional departments, including marketing, product planning, styling, advanced engineering, detailed engineering of major systems such as body and engine, production engineering, and factory operations. A project leader supervised the platform team, although individual team members retained ties to functional departments.

The platform team played a central role in helping lean-producers break traditional inefficiencies of mass production. Under mass production a new project moved along slowly from one functional department to another, as from marketing to engineering to factory operations. Decisions were made within each functional department based on narrow criteria relevant to the specialization. Designers looked for contemporary styling, market analysts wanted features that consumers desired, salespeople desired low prices, engineers sought higher compression engines. When a problem was identified under mass production, individuals went off and thought about it on their own. If factory operations had trouble creating a die, for example, the project was sent back to the engineers, who in turn might send it back to the designers. Under lean production a team worked through a problem together.

With so many specialists involved in a new project, a mass-producer would appoint a coordinator, but the coordinator held little power and was generally unable to have an impact on team members' career prospects or even to gain access to their personnel files. A member of a mass production team was evaluated by a senior executive with the same technical specialization, and prospects for promotion were enhanced by contributions made to that functional division. For example, a chief piston engineer reported to a deputy chief engineer, who reported to a chief engine engineer, and so on. Lean-producers appointed a team leader who actually supervised the various specialized team members, and career paths were affected by performance in creating a new platform.

The self-contained platform team lost favor among car makers trying to cut development costs under optimum lean production. A lean production platform team worked in isolation from the company's other platform teams, but under optimum lean production a new product shared as many components as possible with other platforms, as well as with previous generations of platforms. A development team needed to decide which components in a new model had to be entirely new and which could be taken from the company's large collection of other current or past models. Proliferation in the number of products made it hard for a team to be aware of

everything else going on in the company. Individual models shared many basic components with other models, but were fitted with distinctive sheet metal, trim, and interior finishings in order to attract different types of customers. To be better informed about the company's wide range of products from which commonality was possible, development team members were encouraged once again to work with their functional departments as well as with other team members. The increasingly complex patterns of communication among team members and functional specialists were facilitated by the concept of co-location.

Co-location Saves Money. It has been said that "any person who knows how a vehicle comes to life is aware that vehicle designers and body engineers tend to be the Hatfields and the McCoys of the auto industry."[16] Co-location integrated design and engineering into virtually one system and facilitated rapid communication among the diverse group of specialists working on a new project without their having to work in the same place.

Designers and engineers at different stations could view the same prototype at the same time on a high-definition television linked to a satellite broadcast. Full-color laser holography gave a three-dimensional appearance in which the vehicle seemed to hover slightly behind the screen.

Designers developed the shape and appearance of the new vehicle based on styles and dimensions identified during initial market research. Before a company decided to build a new vehicle, it conducted elaborate market studies to identify a potential group of buyers and determine the group's demands and expectations. Consumer satisfaction with products sold by competitors influenced the establishment of target standards for the proposed new vehicle. Designers who had once made sketches on paper relied instead on computer-aided design (CAD). With team members working simultaneously, designers did not have to wait a long time while engineers confirmed the workability of the designs.

Engineers made certain that the designs could be mass-produced precisely and that the components fit together without excessive gaps and interference. Did doors open and close properly, did the powertrain actually fit into the engine compartment, could the hood close over the engine? In the past, functional divisions within the manufacturer and major suppliers constructed models of components from clay, plaster, wood, plastic, and cardboard. These models were brought together and assembled into a full-scale prototype of the proposed vehicle. Under optimum lean production, manufacturers used computer software instead, with physical models built

later in the process to check fit. Extremely accurate images of parts were created through a process called stereolithography, in which computer design data gave directions to a laser that heated a light-sensitive photopolymer capable of building an image of the part one layer at a time.[17]

Once researchers identified a new vehicle's appearance, specifications, production costs, and potential customers, corporate officials verified that it would return a sufficient investment to shareholders and then approved its production. Individual components then had to be designed, often in consultation with outside suppliers, who were connected through computer links to speed the development process. A major reason why GM took longer than other companies to develop new vehicles was that in 1998 its Delphi Automotive Systems had 1,720 different computer systems for production, 1,800 for finance, and 400 for human resources.

Tools, dies, and machines had to be built to make components and put the vehicles together. Mass-producers waited until detailed specifications had been drawn before ordering new dies made. It could take two years from the time when a manufacturer placed an order until new dies were ready for stamping. Under lean production, die designers and body designers worked together on the same team, so die production could begin at the same time as the start of body design, saving development time. Die designers knew the approximate size of the new car and the number of panels, so they ordered blocks of die steel and made rough cuts in the steel. When final panel designs were released, they could complete the final cuttings quickly.

Under optimum lean production, the dies could be developed simultaneously with the product design at computer workstations. Using designers' CAD data, engineers could simulate factory operations and do a virtual assembly. Intelligent, ultra-high-speed, numerically controlled machine tools sped development of dies, jigs, and other tools. Prototypes of new vehicles could be tested through computer simulation, reducing the amount of time taken up in testing in a laboratory or on a road.[18]

Saving even more time, optimum lean production sharply reduced the number of unique machine tools needed in the factory, from a couple of hundred under mass production and lean production to a couple of dozen. For example, a single large transfer press capable of stamping an entire floor of a vehicle in one piece replaced many individual presses that stamped separate sections of car then welded them together to form the floor.[19] In this respect, optimum lean production more closely resembled craft production than mass production or even lean production. Under

both craft and optimum lean production, a handful of general-purpose machines were used to make a large variety of products.

Consolidation Saves Money

To achieve increasing economies of scale, manufacturers consolidated in two ways. First, the number of products was consolidated, so that they could be built in larger batches. Second, the number of independent vehicle manufacturers was consolidated through joint ventures and mergers.

Consolidation of Products. To maximize efficiency, mass-producers turned out large numbers of essentially identical vehicles. Ford's decision to build only the Model T during the 1910s and 1920s was the first prominent example of this approach. At the height of mass production in the 1950s, Chrysler, Ford, and GM together sold 6 million cars a year in North America off only nine basic platforms, three by each company. More than 1 million cars a year were built from Ford's low-priced platform and from GM's low- and mid-priced platforms. Responding to consumer demands for greater variety (discussed in more detail in the second half of this book), the Big Three increased the number of platforms during the 1960s and 1970s to about forty. Average sales per platform thus declined from about half a million to a quarter of a million, still a manageable volume for a mass-producer. The domestic companies coped by assigning each of their assembly plants to mass-produce a unique platform. Through mass production, a typical assembly plant could turn out vehicles at a rate of about one a minute, so two shifts operating full time with normal summer and winter holidays could produce about a quarter-million vehicles a year. In contrast, the best-selling platforms during the 1950s had been built at several assembly plants in major cities around the country.

A fundamental feature of lean production was the manufacture of a wider variety of products in smaller batches than was possible under mass production. Japanese companies offered about thirty car platforms in the United States, and sold about 2.5 million a year during the 1980s. Only five of the thirty car platforms exceeded annual sales of 100,000 and Honda's Accord was the only one to exceed 250,000. At Japanese assembly plants, machines were installed and tasks organized to produce small batches efficiently. The complexity needed to turn out a large variety of products in small batches was transformed from a logistics nightmare into an asset.

Optimum lean production reversed the lean production trend by reducing the number of distinctive platforms. Japanese-owned companies sold

about 3 million cars a year in the United States during the 1990s, based on about sixteen platforms—roughly 20 percent more cars with one-half the number of platforms. Seven of the sixteen platforms typically sold at least 100,000 vehicles in North America, and Honda and Toyota each had two platforms that sold more than a quarter-million.

Under lean production, each assembly plant produced a unique platform, so a company achieved acceptable economies of scale if it could sell at least a quarter-million of each platform—essentially the output of one assembly plant. Under optimum lean production, development and marketing costs increased to the point that economies of scale were reached by selling 1 million vehicles from one platform. Given the high cost of developing new platforms, companies tried to get as many sales as possible from each, closer to the approach of mass production than to that of lean production. As had been the case under mass production, several assembly plants were assigned to produce the same platform.

Ford and General Motors were the only companies able to sell at least 1 million vehicles a year from single platforms in only one country—in both cases, their most popular truck platform in the United States. Both companies placed a variety of pickups and sport utility vehicles atop their popular truck platforms. Other companies achieved the 1 million level by selling vehicles made from a single platform in more than one market. In 2000 the world was divided into four roughly equal-sized markets: Japan, North America, Western Europe, and the rest of the world. To exceed 1 million, manufacturers had to sell vehicles from the same platform in at least two of the four markets. In 2000 Toyota was the only manufacturer to compete in all four markets with a single platform, sold in much of the world as Corolla. Volkswagen and Fiat also exceeded 1 million in 2000 by selling small-car platforms in two of the four markets—Western Europe and the developing world.

Ford tried and failed twice during the 1990s to develop a car that could be successful in both Western Europe and North America. The company's much publicized World Car strategy was designed to create a single car that fit the subcompact class in North America and the "C" class in Europe and the rest of the world. Ford did sell a car named Escort in all of the markets, but the Escorts sold in different parts of the world resembled each other in little more than name.

Escorts sold in North America had larger engines, softer suspension, and more comfortable seats than in the rest of the world. Americans demanded automatic transmissions and air conditioning. Europeans pre-

ferred hatchback bodies, Americans notchbacks. But the most critical difference was not the equipment but the width of the car: the same platform could not be used because the Escorts sold for the narrow, crowded city streets of Europe were narrower than those sold for the wide-open freeways of the United States.

Ford tried again to create a world car in the early 1990s, with a compact for North America and "D" class for the rest of the world. Sold in the United States as the Ford Contour and in the rest of the world as the Mondeo, the car cost $6 billion to develop. Europe delivered its half of the desired 1 million sales per year, but North America couldn't muster its share. The car's dimensions were competitive for its class in Europe, but too small for North America, especially the rear seat. The North American Contour was squeezed between Ford's Escort (not much smaller but much cheaper) and Taurus (much bigger yet only slightly more expensive). Worldwide sales exceeding 1 million a year through the 1990s could have brought Ford's development costs down to the $500 per vehicle range, but with sales only about one-half million a year, each Contour/Mondeo represented about $1,000 in development costs.

Ford merged its European and North American operations to integrate its search for a feasible world car. Four product development centers were identified, with Ford Europe taking worldwide responsibility for smaller cars, and North America for larger cars and trucks. The first small car developed under this system, the Focus, which replaced the Escort in 1999 in Europe and in 2000 in North America, was Ford's first vehicle to sell well in both Western Europe and North America since the Model T.

Manufacturers also drastically reduced the number of trim levels, option packages, and stand-alone options. For example, Ford reduced the number of variations of cars by 50 percent in 1998 compared to 1997, then in 1999 it reduced the number of variations of cars by another 30 percent and the number of variations of trucks by 47 percent. Between 1998 and 1999 Ford cut the number of possible trim and option combinations on the Windstar minivan from more than 1 million to 100,000; those on the Explorer sport utility vehicle from 465,000 to 50,000; and those on the Expedition sport utility vehicle from 410,000 to 40,000.[20]

Consolidation of Companies. What if a company could not sell 1 million vehicles from one platform or even build a quarter-million to fully utilize an assembly plant? It was clearly time to look for partners to share output of the platform, or even to acquire another company to spread devel-

opment and production costs of a platform across more than one nameplate.

Under lean production, where the efficient unit of scale was the assembly plant, producers established several joint ventures to share the output. General Motors and Toyota established a joint venture called New United Motor Manufacturing, Inc. (NUMMI) that started production in 1984 in an assembly plant in Fremont, California, which GM had shut two years earlier. Toyota had first talked with Ford about a joint venture, but the two could not reach an agreement.[21] The plant produced Toyota Corolla and mechanically similar Chevrolet Nova (later Geo and Chevrolet Prizm) models.

Mazda, faced with difficulties in fully utilizing a North American assembly plant, created a joint venture with Ford called AutoAlliance International, to build sports cars in Flat Rock, Michigan, beginning in 1987. The vehicles shared engines but had different bodies. Mazda later added a mechanically similar sedan to the plant. At other plants, Ford agreed to build a minivan for Nissan and a pickup truck and sport utility vehicle for Mazda.

Like Mazda, Mitsubishi was having trouble projecting the quarter-million annual sales needed to justify an assembly plant in North America, so it approached Chrysler, which then owned one-fourth of it, to share a plant. The company, known as Diamond-Star, after the symbols of the two companies, opened in Normal, Illinois, in 1988, initially to produce sports cars sold under a variety of Mitsubishi and Chrysler nameplates. Two Japanese companies, Isuzu and Subaru—neither of which could justify a North American assembly plant—went in together on a plant in Lafayette, Indiana, which opened in 1989.

The joint venture assembly plants solved specific problems for Japanese companies eager to enter the North American market and for U.S. companies eager to offer more models. But the joint ventures never expanded into larger scale partnerships or acquisitions. They merely plugged gaps, rather than playing a central role. Under optimum lean production, the rationale became even more tenuous. Optimum lean production raised the stakes on car makers to produce platforms capable of selling 1 million a year—around the world if necessary. Rather than seeking joint ventures to fill an assembly plant, companies looked for acquisitions to achieve the higher level of economies of scale of development and production under optimum lean production.

The blockbuster, late-twentieth-century acquisition was Daimler-Benz's 1998 takeover of Chrysler Corporation. The two companies had relatively little product overlap, and both were already operating their assembly plants at capacity. The consolidation pulled DaimlerChrysler into the top ranks of world vehicle producers, and provided the basis for further expansion that did offer beneficial economies of scale, starting with acquisition of controlling interest in Mitsubishi Motors in 2000.

However, within two years of the takeover DCX had tumbled from the most profitable to the least profitable of the major car makers. Economies of scale were not realized, because former Daimler-Benz managers were reluctant to share engineering and components with Chrysler, fearing that the reputation of the Mercedes-Benz luxury brand would be damaged. Profits eroded when DCX officials failed to maintain Chrysler's notably tight cost controls over development and production, then alienated long-time suppliers by demanding large price cuts. Because of shortsighted engineering and poor design, DCX's underutilized assembly plants couldn't be retooled to produce profitable vehicles in short supply, such as the PT Cruiser. Mitsubishi was burdened with high debt, poorly selling models, and secret recalls that had been illegally hidden from the Japanese government for at least twenty years. DCX's problems called into question the benefits of consolidation unless meaningful economies of scale could be achieved in the actual product lineup.

Ford targeted several European luxury vehicle makers for acquisition during the 1990s, including Jaguar, Volvo, and Land Rover. Faced with high development costs because of limited sales for its Lincoln luxury nameplate, Ford was able to share highly profitable luxury-brand platforms among Jaguar, Lincoln, and Volvo. At the other end of the market, Ford expanded its ownership of Mazda Motors to a controlling interest, so it could share smaller platforms among Asian, European, and American brands.

General Motors's major effort to expand platform sharing was acquisition of controlling interest in Fiat. The link with Fiat had little impact on GM's North American operations, but a small car platform marketed under a variety of Opel and Fiat nameplates was in a position to sell well over a million in the rest of the world. In Japan, GM acquired control of Fuji Heavy Industries, makers of Subaru vehicles. GM had already held stakes in Isuzu Motor Ltd. and Suzuki Motor Corporation since the 1970s.

Troubled Renault gained control of even more troubled Nissan so that

the two companies could share platforms. In particular, Nissan, which had a reputation for quality in Japan and North America, could sell some products made by Renault, which was not active in either market and had a lingering reputation for poor quality in North America from its history of selling vehicles under its own name. Renault also was remembered in North America for its unsuccessful effort to run American Motors before selling it in 1987 to Chrysler, which turned Jeep into a valuable nameplate in the 1990s. Renault also took controlling interest in the Romanian car maker Dacia in 1999, and the Korean car maker Samsung in 2000.

Under the leadership of Renault executive Carlos Ghosn, Nissan's financial situation improved quickly, from a record $6.5 billion loss in 1999 to a $1.6 billion profit during the first half of 2000. Ghosn moved quickly to close several of Nissan's inefficient plants, lay off tens of thousands of workers, and slash supplier costs.

As a result of such acquisitions, by 2000 the six largest manufacturers—GM, Ford, Toyota, Volkswagen, DCX, and Renault—produced 80 percent of the world's vehicles, while in 1990 the six largest had accounted for 54 percent. The ten largest manufacturers accounted for 94 percent of global production in 2000, compared to 70 percent a decade earlier. Through acquisitions, General Motors increased from 15 percent of world production in 1990 to 25 percent in 2000, Ford from 12 percent to 16 percent, and Volkswagen from 6 to 9 percent; through acquisitions, DCX and Renault joined the Big Six. Toyota, which was not involved in acquisitions during the 1990s, held steady at 10 percent of world production in both 1990 and 2000.

Production also became concentrated among fewer producers during the 1990s in the three major markets of the world—Europe, Japan, and North America. In Europe, consolidation had the most impact: the five largest manufacturers in 2000 (Ford, General Motors, Peugeot, Renault, and Volkswagen) held 80 percent of the market, compared to only 50 percent a decade earlier. In Japan, the five largest manufacturers in 2000 (DCX, GM, Honda, Renault, and Toyota) held 88 percent of the market, compared to 84 percent a decade earlier. In North America, five companies (DCX, Ford, GM, Honda, and Toyota) held 86 percent of the market in 1900 and 89 percent in 2000. No company ranked among the top five in sales in all three of the major regions in 1990, and only Ford, GM, Honda, and Toyota ranked among the top five in two of the three regions. Following acquisitions during the 1990s, GM became one of the top five compa-

nies in each of the three markets, while DCX, Ford, Honda, Renault, and Toyota were among the top five in two markets each.

Mass production brought a decrease in the number of major car makers, because the more vehicles a company sold, the lower were the unit costs, and larger batches of identical parts and vehicles could be produced. Lean production temporarily reversed the consolidation trend, because companies producing 2 million vehicles a year were just as well able to achieve economies of scale as companies producing more than 5 million. Optimum lean production returned the motor vehicle industry to lean production's pattern of fewer, larger companies, capable of dominating production around the world, not just in one country.

3 *From Making Parts . . .*

Eiji Toyoda told me himself . . . there was no mystery to the development of Toyota in Japan. He merely came to see the Ford Rouge Plant in 1950—and then went back to Japan and built the same thing.

—Phillip Caldwell, Ford president (1978–80) and chairman (1980–85)

THE AUTO industry's second major Fordist production achievement early in the twentieth century was *vertical integration,* which means the control of all phases of a highly complex production process, from initial research to final sale. Vertical integration created an hourglass structure in the automotive industry: thousands of companies supplied parts and materials to a handful of manufacturers that assembled motor vehicles and then shipped them to thousands of dealers.

Vehicles were assembled almost entirely from purchased parts during the first decade of the twentieth century, although pioneering producers had to fashion some parts themselves when they could not find any supplier.[1] Many of the pioneer companies perished because they depended on assembling parts made by unreliable suppliers. The purchase of most parts from independent suppliers meant that early vehicle assemblers were "plagued by problems of irregularity of production, loss of materials in transit and through embezzlement, slowness of manufacture, lack of uniformity and uncertainty of the quality of the product."[2] A stoppage in a supplier's plant could prove fatal to a car maker that had limited operating capital and no reserves.

By 1910 the surviving vehicle producers had undertaken to make for themselves parts that others would gladly supply, but which seemed vital for the auto makers to control. The principal motivation for Ford and other car makers in installing moving assembly lines and other mass production innovations was to guarantee a supply of parts rather than to lower production costs.[3]

The ability to make one's own parts was a source of strength and a measure of high quality and efficiency at GM and Ford, and to a lesser extent at Chrysler, through most of the twentieth century. Other producers, who made a smaller percentage of their own parts, were driven from the U.S. market because they had to buy from outside suppliers parts that were more expensive and of lower quality than those made by the Big Three. Smaller companies had to charge higher prices than the Big Three for vehicles of comparable quality or else charge comparable prices for vehicles of inferior quality. They could compete with the Big Three in quality or in price, but not in both at the same time. Only the Big Three could afford the expense of investing in their own parts-making operations. Increasing economies of scale drove out the smaller producers, leaving by 1960 one dominant company, General Motors; a distant second-place Ford; and a barely surviving Chrysler.

All car makers practice some vertical integration, such as product development and engineering at the early stages of production, and final assembly and advertising at the other end. The major variation among car makers in degree of vertical integration is the extent of their control over production of the thousands of parts that go into their vehicles.

No manufacturer ever produced 100 percent of its own parts, although GM and Ford came close at times. But as recently as the 1990s, General Motors made two-thirds of the parts attached to its motor vehicles, Ford about one-half, and Chrysler (then DaimlerChrysler) about one-third.[4] They didn't need to control 100 percent of parts production, just enough to dominate relationships with the companies that supplied the parts.

After a century of expanding vertical integration, motor vehicle producers in recent years reversed the trend, moving toward vertical disintegration. Making most parts in-house was no longer considered a source of strength for the car makers. Instead, they outsourced production of many components to a variety of large independent suppliers. By selling off their parts-making operations, Ford and GM reduced their dependence on in-house parts to DCX's level.

In past decades the vertically integrated Big Three car makers could dominate relationships with small independent parts makers. In recent years motor vehicle producers and suppliers have worked out new relationships based on more nearly equal partnership.

Early on, Ford and General Motors emerged as the two dominant U.S. car makers through vertical integration, although the two companies achieved vertical integration in very different ways. Ford built the world's

largest factory; GM acquired dozens of independent companies. Henry Ford's vision of vertical integration was to bring together at one site, for the production of just one model, as many steps in the production process as he could personally manage, from processing raw materials like rubber, iron ore, and coal, to shipping out finished vehicles. The vision of vertical integration at General Motors was to dominate through acquisition or expansion those parts-making and assembly operations that could achieve the corporation's minimally acceptable rate of return on investment.

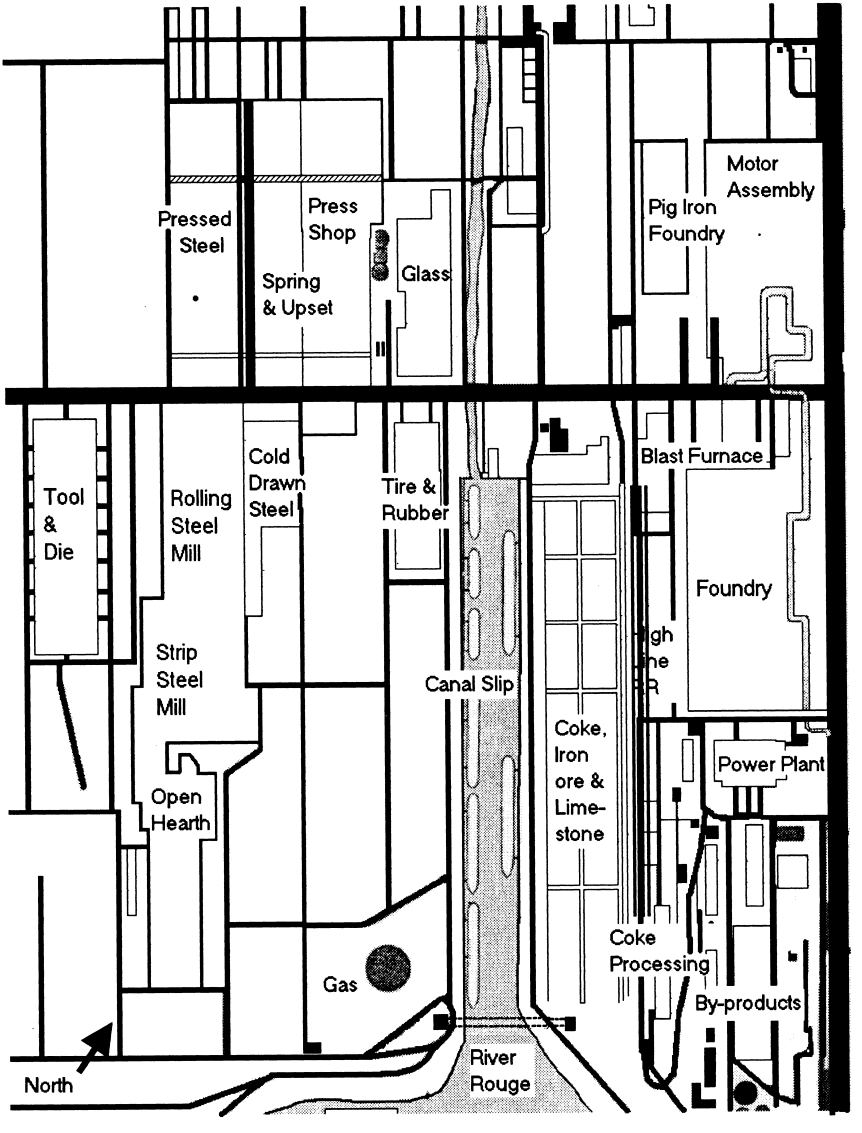
Ford Clusters Production at the Rouge

To achieve vertical integration, Ford created the Rouge, the largest industrial complex in the nation's history. At its peak before World War II, the Rouge employed 110,000 workers in 127 structures, ranging from a 30-square-foot truck scale to a 1.6 million-square-foot steel mill, a total of 11 million square feet, spread out over 2,000 acres. Coal, iron ore, and other minerals arrived at one end of the Rouge, and finished vehicles were driven off at the other end. General Motors followed a different path to vertical integration by acquiring many independent parts makers around the country. Still, Ford bought some individual parts, such as brakes and lights, that GM preferred to make, while producing some of its own "raw materials," such as steel and glass, that GM preferred to purchase.

Within months of installing the moving assembly line at Highland Park, Henry Ford bought the 2,000-acre Rouge site in Dearborn and talked publicly about building a great factory complex. In 1917 he had preliminary blueprints of a self-sufficient factory complex that would dwarf even Highland Park.[5] The River Rouge plant began production in 1918, turning out Eagle boats for the U.S. Navy during World War I. When civilian motor vehicle production resumed after the war, Highland Park remained Ford's principal plant until 1927, when the assembly line was dismantled and moved to the Rouge.

Production operations at the Rouge were organized into six broad functions, clustered at different places around the Canal Slip (Fig. 3.1):

1. Processing of raw materials, immediately east of the Canal Slip
2. Generation of power, adjacent to the raw materials processing area
3. Casting of iron components, north and east of the raw materials processing area
4. Production of steel and steel components, west of the Canal Slip



3.1. Plan of Ford Motor Company River Rouge plant, c. 1940. (Adapted by the author from multiple sources)

5. Production of other components, northwest of the Canal Slip
6. Final assembly of vehicles, northeast of the Canal Slip

Most of the Rouge complex was constructed during the late 1910s and 1920s. Raw materials processing, power generation, and iron-casting operations were largely in place by the early 1920s. Most of the buildings for making steel and other components were added during the 1920s. Final-assembly operations were added in 1927, but placed in one of the first major buildings to have been completed, in 1918. Substantial additions were made in the 1930s, and a few more buildings were added in the 1940s for war-related activities. The planning of each new structure at the Rouge began with a discussion of its purpose. Blueprints were drawn, but because Henry Ford evidently could not read them, a three-dimensional scale model was also created, showing such details as placement of windows, machines, pillars, and conveyors. Changes were considered by moving around elements of the model (Fig. 3.2).

3.2. Henry Ford and his son Edsel examining a model of the River Rouge plant. The tall stacks near Edsel are the Power House. The Motor Assembly and Foundry buildings are near Henry. (From the collections of Henry Ford Museum & Greenfield Village)

At the height of its importance in the 1930s, the Rouge attracted 100,000 visitors a year, a busload every hour. The Rouge's 100 buildings and 11 million square feet must have overwhelmed visitors, especially when the guide spouted a torrent of statistics: 15 million square feet of glass, 92 miles of railroad tracks, 10 billion gallons of water, 16,000 gallons of paint, 5,000 mops, 3,000 brooms, and 86 tons of soap used per month.

Processing of Raw Materials

The key concept in understanding how Henry Ford envisioned the Rouge was materials flow. At Highland Park, Ford had solved the problem of flow of materials within the factory, but he also wanted to control the flow of materials to the plant. With the invention of the moving assembly line, Ford believed that future cost savings were "likely to come from moving rather than from making."[6] That meant owning the mines where the raw materials were extracted, the transportation by which the materials were moved to the factory, and the ovens where the raw materials were processed.

As the world's dominant motor vehicle producer, Ford Motor Company could have wielded enormous power over miners, transporters, and processors of coal, iron ore, and other raw materials—the strategy that General Motors followed successfully. But for Henry Ford, direct control over sources of raw materials was "buying insurance against non-supply." His assistants often heard him express fears of shortages, high prices, and strikes that could disrupt production.[7]

Henry Ford was outraged when a coal miners' dispute forced him to halt production for several days in 1922, and he felt even more strongly when the Interstate Commerce Commission allotted the scarce supply of coal to "essential" industries, which it defined as including public utilities and food manufacturing plants but not car makers. A few months later Ford bought three groups of coal mines in Kentucky and West Virginia, and incorporated the Fordson Coal Company to manage them. When these were added to mines bought in 1920 in Wallins Creek and Tisdale, Kentucky, and Nuttalburg, West Virginia, Ford Motor Company was mining more coal than it needed, so it sold some to the public.

For iron ore—the other especially important mineral—Ford in 1920 acquired the Imperial iron ore mine at Michigamme, 80 miles north of Iron Mountain, on Michigan's Upper Peninsula, and began limited operations in October 1921. But the Imperial could provide only a small amount of Ford's iron ore, and its poor quality provoked complaints from Rouge

technicians, so most of Ford's iron ore was purchased from mines in Minnesota's Mesabi Range, then the country's major iron ore production area.

To move coal from Appalachia to the Rouge, Ford acquired the Detroit, Toledo & Ironton Railroad in 1920. The DT&I, started in 1874, originally wandered through rural western Ohio, later was pushed south to Ironton on the Ohio River, then north to Detroit, with a spur east to Toledo—a total of 456 miles. The line served coal and iron ore mines in western Ohio and southern Michigan, but when these fields were exhausted, revenues declined, and it fell into such poor condition that Appalachian coal shippers avoided it.

When ordered by the Interstate Commerce Commission to reconstruct its bridge across the River Rouge, the bankrupt railroad was unable to comply. Henry Ford took over the DT&I, refurbished the track, reconstructed bridges, and cut the work force in half—although he raised wages and reduced working hours for those remaining. Ford made a profit on the railroad beginning in 1923, then sold it in 1928 to the Pennroad Corp., associated with the Pennsylvania Railroad.

Henry Ford may have fallen into railroading by happenstance, but he was a fanatical advocate of sea transport as the most economical means of moving raw materials to his factories. In 1917 he ordered that all Ford factories be built adjacent to deepwater facilities.[8] Given his fascination with sea transport, Ford's top priority in developing the Rouge site was to secure a deep sea harbor. The River Rouge flowed along the property's western and southern borders. At the southeast corner of the site, the Rouge made a sharp ninety degree turn from an easterly to a southerly direction, before flowing into the Detroit River three miles to the south. The Detroit River was navigable by large ocean-going ships, but the River Rouge was not.

Henry Ford drew up plans to dredge the Rouge, but before the plans were implemented, the United States entered World War I. Ford proposed applying his mass production methods to making a large number of Eagle boats that could hunt down German submarines. The boats would be manufactured in the Detroit area and sent to service in the Atlantic Ocean by way of the Detroit River, Great Lakes, and St. Lawrence River. Because the Highland Park plant was tied up making Liberty engines for airplanes, the U.S. government agreed to build a $3.5 million plant on the Rouge site for Ford to make 112 Eagle boats, and to sell the plant to Ford after the war when automotive production could resume.

The first ships were built while the plant was still under construction,

but production difficulties and labor shortages slowed output. Only seven boats sailed from the plant before Armistice Day, November 11, 1918, only two of which reached the Atlantic. Another fifty-three boats were finished in late 1918, after the war was over. The company and the government agreed to cancel the contract for the remaining fifty-two.

To launch Eagle boats from the plant, the federal government improved the three-mile stretch of the River Rouge between the plant and the Detroit River. The government widened and dredged the river, constructed a 3 million-square-foot turning basin in the Rouge near the sharp bend at the southeast corner of the Ford property, and extended a half-mile canal, known as the Slip, from the river northward into the middle of the Ford property. The government also drained swampy land on the site, diverted creeks, and constructed new bridges.

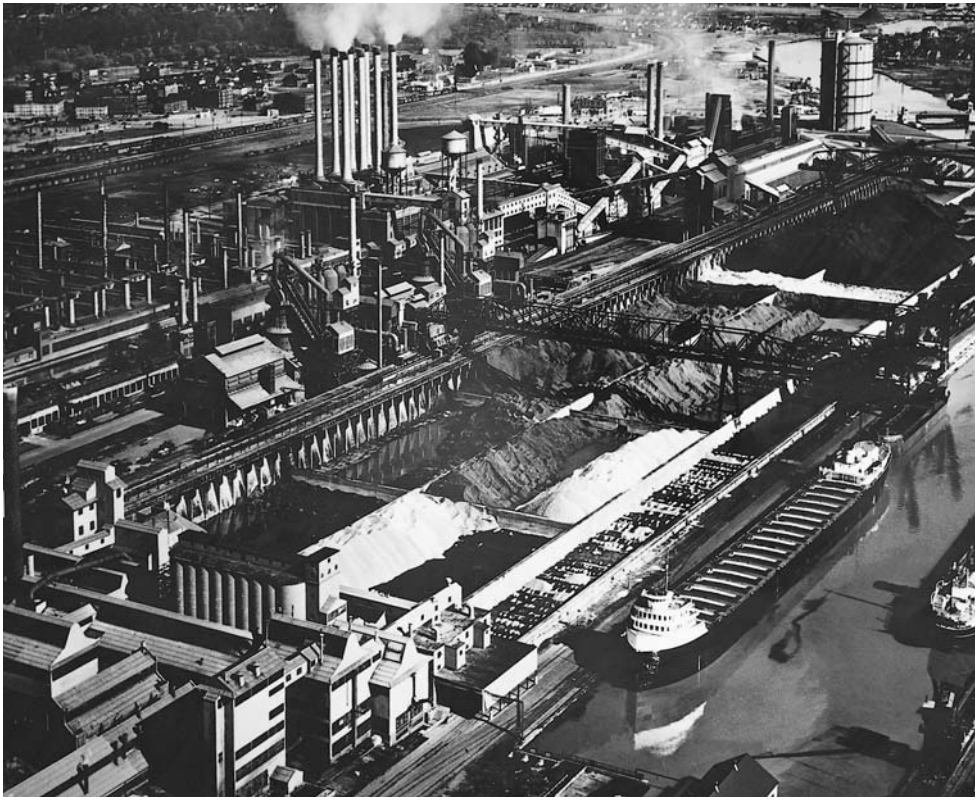
Henry Ford purchased a fleet of ships to bring raw materials to the Rouge. The two largest ships on the Great Lakes, named for his grandsons Henry Ford II and Benson Ford, brought iron ore from Duluth, Superior, and Marquette. Barges brought limestone from northern Michigan and some coal from the south, although most coal came in by rail.

Enormous storage bins lined nearly the entire one-half-mile east side of the Canal Slip, large enough to stockpile materials through the winter, when ice shut down ship traffic in the upper Great Lakes. Coal came to the Rouge mostly in bottom-dumping rail cars, which traveled up a 40-foot-high elevated track, called the High Line, along the east side of the bins, to dump their loads down into the bins. Iron ore and limestone were moved by unloaders from ships to the bins (Fig. 3.3).

High Line rail cars moved ore from the bins to the coke ovens, which processed coke for the powerhouse, blast furnaces, and foundry, and also supplied coke to Highland Park.[9] Gases burned off in coke ovens were captured and treated in the By-Products Plant, located east of the coke ovens, and used for heating throughout the Rouge complex.

Generation of Power

The most visible structure on the Rouge skyline was Power House Number 1, a 250,000-square-foot structure along Miller Road north of the coke ovens, topped by eight 500-foot-high, tightly packed smokestacks. Eight turbogenerator units supplied enough electricity for a city of half a million people. Two dozen substations distributed power around the Rouge, and the Rouge powerhouse supplied one-third of the power needed by the Highland Park plant, twelve miles away. Production of his own electricity



3.3. Ford Motor Company, River Rouge plant, aerial view, c. 1940. Storage bins for coal, iron ore, and limestone lined the east side of the Canal Slip, which reached the Detroit River (background). High Line rail cars moved the ore from the bins to the blast furnaces (to the left of the bins). Tall smokestacks are the Power House. Final Assembly ("B") building is in the lower left at the end of the storage bins. (From the collections of Henry Ford Museum & Greenfield Village)

was a major part of Henry Ford's drive for self-sufficiency. He had worked as an operating engineer at the Detroit Edison Illuminating Company in the 1880s before building cars, so he appreciated the importance of controlling the source of power.

Henry Ford insisted that the powerhouse supply electricity through direct current rather than alternating current. Ford's preference for DC went back to his employment at Detroit Edison, and was reinforced by his later friendship with Thomas A. Edison, the most prestigious advocate of DC. Ford met Edison after hearing him give a speech in Atlantic City in 1887,

and Edison encouraged Ford to continue working on a gasoline engine despite the promise that electric cars held at that time. After Edison died, Ford moved his laboratory at Menlo Park to Greenfield Village.

The debate between DC and AC had been largely settled in favor of AC by the 1920s, but Ford still argued that the higher voltage required for AC posed a hazard to factories, and he insisted on converting to DC all of the Rouge generators geared to AC. But DC generators were inefficient, losing 15 percent of power. Workers had difficulty keeping the Rouge motors in operation, because units burned out when the armatures of partially open DC motors became clogged with dust and grit. In the 1920s Ford finally gave in, authorizing conversion of the Rouge to AC power, at a cost of $30 million.

Casting of Iron Components

Ford's casting operations comprised three main elements. First, blast furnaces smelted iron ore into molten iron. Second, the molten iron was taken to the foundry to be converted into gray iron castings. Third, the castings formed in the foundry were sent next door to the motor assembly building, where the engine block was cast, or to the machine shop, where other iron components were made. In addition, by-products from the blast furnaces were used to produce fuel and make cement.

In a typical casting operation, molten iron is poured into molds and hardened to produce pig iron, and the pigs are remelted and shaped for use in the foundry. Ford tried to eliminate the need for pig iron by taking molten iron directly from the blast furnaces to the foundry in open-top ladles set on flat cars. In principle, carrying molten iron to the foundry for mixing with other hot metals saves time, labor, and expense of producing and remelting pigs. The challenge was to move the molten iron to the foundry fast enough to prevent its hardening. Ford eventually abandoned the idea of moving molten iron and added a pig iron building near the blast furnaces and the foundry.

The Rouge foundry, situated east of the blast furnaces and west of Miller Road, was the world's largest: 1.2 million square feet (over 30 acres) in area, 595 feet wide, 1,188 feet long. The foundry, with a capacity of 2,900 tons of castings per day, made nearly all of Ford's brass, bronze, copper, and alloy steel castings, as well as gray iron. At the foundry, the hot metal brought over from the blast furnaces was poured into a 1,200-ton mixer, reheated in an electric furnace, and poured into molds for cylinder blocks and smaller parts. Forging machines produced wrought iron, formed by heating and

hammering the iron with a large metal ram or hammer dropped onto a base holding a metal die with the desired form sunken into it.

The most important and distinctive casting was for the engine cylinder block. The Ford V-8 engine cylinder block was cast in a single piece, requiring 43 cores. Casting an engine in a single unit was a source of great pride to Henry Ford, because it was a technical feat considered impossible at the time by other car makers. The crankshaft was cast in the foundry of alloy steel, also in one piece.

Ford claimed that his foundry was the cleanest and coolest in the world, not merely the largest. Air conditioning and ventilation systems carried away much of the smoke and heat, and Ford's materials-handling system reduced the physical burden for the foundry's 10,000 workers.[10] Nonetheless, foundry work was considered the hardest work in the Rouge, and African Americans made up a very high percentage of foundry workers.

Production of Steel and Steel Parts

The Rouge was the only car manufacturing complex to have its own steel-making capacity. Four main steel-making buildings were erected west of the Slip during the 1920s: the Open Hearth, the Steel Mill, the Pressed Steel Building, and the Spring and Upset Building. Added during the 1930s were the Press Shop, Tool and Die Shop, and Cold and Hot Strip Mills.

The open hearth furnaces melted pig iron (or in Ford's case mixed molten iron) with other materials, and the molten metal was poured into molds. The molds formed the metal into shapes, known as ingots, weighing 5–10 tons. The ingots were taken to the steel mill, where they were reheated in a "soaking pit" to a proper temperature for rolling into billets or sheet bars, ready for use. From the steel mill the various types of metal were routed to different departments, where they were made into finished parts.

The Pressed Steel Building, immediately north of the steel mill, contained thousands of machines for stamping and welding steel sheets into such parts as fenders, hoods, radiator shells, and body panels. The Pressed Steel Building was converted to the Rear Axle Building during the late 1930s. The differential carriers and gear cases, made from malleable iron castings rather than from steel, were taken by truck to Ford's Mound Road plant for installation in transmissions. (That plant also made engine cylinder sleeves for tractor engines after World War II.)

Most of the forgings were done in the Spring and Upset Building, immediately east of the Pressed Steel Building. The Spring and Upset Build-

ing included thirty-seven spring-forming machines that shaped and tempered the tapered spring leaves. Fifty-nine forging or "upsetting" machines performed punch-and-die operations that produced such metal parts as the crankcase, front spindle, hub and brake drums, steering rod, and radiator shell. Ford added a Press Shop in 1938 containing the world's largest stamping operation. It was housed in an L-shaped building wrapped around the east and south sides of the Spring and Upset Building.[11]

Production of Other Components

Ford was the only motor vehicle manufacturer to make its own glass. Scarcity of glass and high prices during the World War I era influenced Henry Ford to get into the glass-making business. The company shipped in silica sand, limestone, dolomite, soda ash, sodium sulfate, rouge, and carbon, and melted the ingredients in two 75-ton melting furnaces. Molten glass running from the furnace was rolled into continuous ribbons, then cut into lengths for grinding and polishing. The Rouge was the first glass plant to turn out plate glass through a continual rolling process.[12]

Coatings and bonding materials were made at the Rouge from corn; alcohol, anti-grease, and shock absorber fluid were made from sugarcane. Lard oil was used for rear axle lubricants, and flax oil for paints, core oil, soft soaps, and glycerine. Top material, enamels, varnishes, and brake linings came from tung oil; turpentine, rosins, and other solvents, from pine pitch. Gaskets were made from cork, electrical embedding compounds from beeswax.

Ford was the first large motor vehicle producer to make its own bodies rather than purchasing them from independent suppliers. When the Rouge complex was started, most car bodies were still made of wood. Ford controlled millions of acres of forests, especially in northern Michigan, and operated a sawmill in Iron Mountain. Timber was sent by barge through the Great Lakes to the Rouge. A sawmill was built at the head of the Slip. The Rouge made upholstery for seats and carpet for floors from cotton, wool, cowhide, mohair, and jute. These natural materials were purchased from outside sources.

Ford ground soybeans and molded the meal into several other components, including window strips, horn buttons, light switches, and gear shifter knobs. Ground soybean was also used for protective and decorative body finish coatings, as well as green bond for the foundry, and cementing glues.[13] The knobs on the end of Ford's steering column–mounted gear shifters were especially popular with children, who liked to lick them. Lit-

tle did they know that the swell-tasting black Tootsie Roll Pop look-alike on the end of the gear shift was made from soybean.

Ford planted more than 5,000 acres of soybeans in southern Michigan, including several hundred acres in Dearborn itself, along Southfield Road and Airport (now Rotunda) Drive. For Henry Ford, the principal purpose for planting soybeans—more important than providing raw materials—was "to provide for farmers an effective object lesson as to how they may profitably employ part of their time and acreage in growing simple crops for industrial uses." This was in line with "one of Henry Ford's greatest ideals[,] to bring about the decentralization of industry through the closer cooperation of farm and factory." Ford stopped processing soybeans during World War II, and sold the principal processing plant at Saline, Michigan, in 1946.[14]

Ford made tires at the Rouge, as well as hundreds of rubber parts, including mountings, hoses, gaskets, mats, running board covers, insulation, steering wheels, and top material. A 500,000-square-foot Rubber Products Building was added in 1937 at the northwest corner of the Slip. To assure a source of rubber, Ford had planted rubber plantations in Brazil during the 1920s, with assistance from the Brazilian government, eager for investment. Brazil had had a monopoly on rubber in the late nineteenth and early twentieth centuries, but lost it after the British brought 70,000 rubber trees from Brazil to the Royal Botanical Gardens at Kew, outside London, then transplanted 7,000 seedlings from Kew to plantations in their Ceylon (Sri Lanka), India, and Malaya (Malaysia) colonies. In control of two-thirds of the world's rubber during the 1920s, the British restricted production in order to raise prices sharply. In its deal with Brazil, in exchange for sharing 7 percent of rubber profits with the Brazilian government, Ford received free land, duty-free imports and exports, police protection, and permission to dam the Tapajos River and operate railroads, airports, stores, schools, and a hospital.

Henry Ford also supported experiments by Thomas Edison to make synthetic rubber. Edison made rubber from goldenrod, but it was too expensive and too low in quality for practical use. Ford's rubber schemes and other ideas were hatched on his many camping trips with Edison and Harvey Firestone, founder of one of the largest tire manufacturers in the United States. Ford liked to chop wood, build a campfire, and sit up with his friends talking about literature, mechanical progress, agriculture, and politics. They drove on poor roads (sometimes in larger, more luxurious Packards rather than in Ford vehicles) through the Smokies, Appalachians,

northern Michigan, and New England, with an entourage of helpers to set up tents, chairs, tables, refrigerators, and lights.[15]

Fifteen years after planting—half the development time of the British plantations in Asia—Ford's rubber trees yielded creamed latex. But they never yielded a profit: Ford lost more than $20 million on this venture between 1927 and 1945. Shortly after resuming civilian vehicle production after World War II in late 1945, Ford sold the plantations to the Brazilian government for $250,000.[16]

Final Assembly of Vehicles

The Rouge initially made parts that were sent over to Ford's Highland Park plant for final assembly. When Model T production ended in 1927, Ford terminated final-assembly operations at Highland Park and moved the assembly line to the Rouge. Ford's Model A, unveiled in late 1927, was assembled at the Rouge.

Final assembly took place in a 1 million-square-foot building known until the late 1940s as the B Building. Designed by Alfred Kahn, the B Building was the first large structure completed in the Rouge, northeast of the Slip, in 1918. As described above, the U.S. government had agreed to build the $3.5 million plant on the Rouge site for Ford to make Eagle patrol boats, and to sell the plant to Ford after the war when auto production resumed. The keel of the first 200-foot Eagle boat was being assembled in May 1918 even before the roof of the B Building was completed.

With the end of Eagle production, much of the first floor of the B Building was used as a roughing mill, where logs were cut to convenient sizes before being sent elsewhere for finishing. Bodies and other wood parts were produced at the Rouge and shipped to Highland Park and other final-assembly plants around the country. Bodies were painted on the second floor. The northeast one-fourth of the ground floor stamped door bottom panels and metal around oval back windows, until the Press Shop was constructed in the late 1930s. Rear axles, rear axle gears and shafts, differential housings, torque tubes, universal joints, and other axle and driveshaft components were made from rough castings in the B Building, until the Pressed Steel Building was converted to the Rear Axle Building, also in the late 1930s.

The Ford hospital moved from Miller Road to part of the second floor of the B Building in 1925. The Ford Trade School had classrooms on the fourth floor and machinery for instruction on the third floor. The Rouge laundry and the fire department were set up under the hospital in 1926. When they were not fighting fires, the firemen ran the laundry.

The first motor vehicles assembled in the B Building were not cars or trucks, but tractors. Henry Ford had been committed to building tractors as early as 1906, as part of his dream of improving farm life through practical, inexpensive machinery. After experimenting with several designs, Ford Motor Company began to assemble tractors in 1915, in a temporary factory on the site of the present Engineering Staff Building in Dearborn. The Fordson Tractor was cheap and light, yet durable, with such revolutionary features as small wheels and enclosed working parts. Fordson Tractor production was moved to the B Building in 1921. A huge convoy moved the entire assembly line three miles along Rotunda Drive. Daily production jumped from a handful to 100, later reaching as high as 400.

The first automobile assembled in the B Building was the Model A in 1927; trucks were also assembled there. A second line was added in 1931 to assemble the V-8 model. A third line assembled Mercury vehicles beginning in 1939. During World War II Ford continued to build tractors and added tanks, trucks, staff cars, jeeps, and amphibious vehicles for the military. When the plant was returned to civilian production in 1945, Ford operated four final-assembly lines in the B Building, one each for Ford cars, Mercury cars, Ford trucks, and Fordson tractors.

After World War II Ford cut back on the variety of products assembled in the B Building, which was renamed Dearborn Assembly Plant in 1948. Tractor assembly was moved to Highland Park in 1946, truck assembly a year later. The tractor line was later sent to Ford's plant in Cork, Ireland. Mercury assembly went to a new plant in Wayne, Michigan, in 1952. Left in the Dearborn Assembly Plant in the 1950s was assembly of Ford cars, plus Mercury station wagons. Dearborn Assembly was turned over to the Ford Mustang sports car beginning in the 1960s.

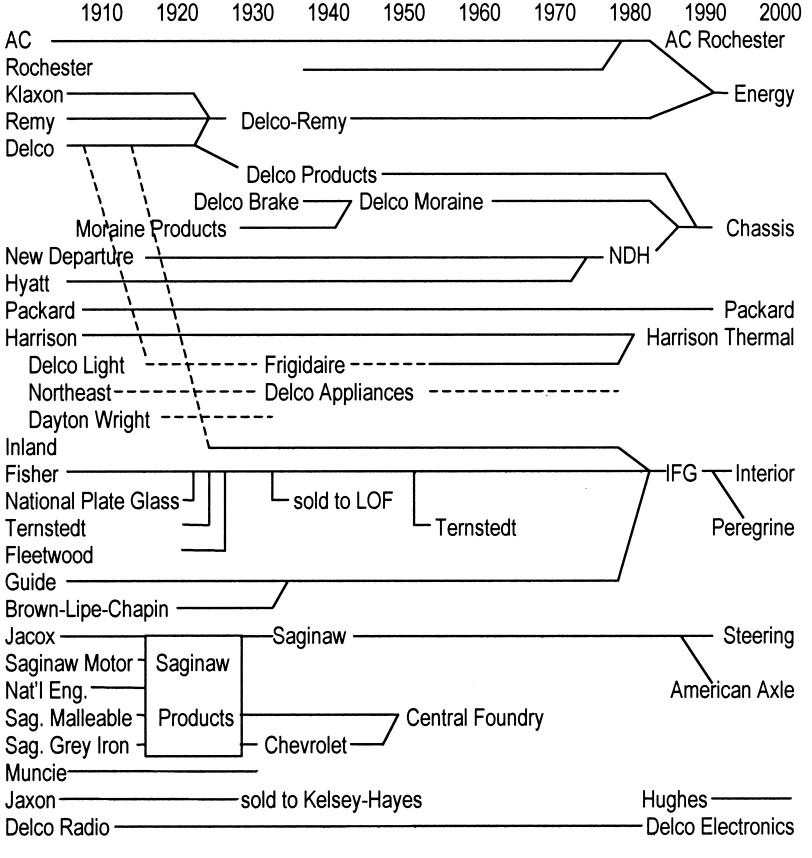
Vertical Integration at GM

General Motors created Delphi Automotive Systems in 1995 as a business unit for its wide variety of parts operations. Delphi initially consisted of six divisions: Delphi Energy and Engine Management Systems, Delphi Steering Systems, Delphi Chassis Systems, Delphi Harrison Thermal Systems, Delphi Interior Systems, and Delphi Packard Electric Systems. A seventh division, Delphi Delco Electronics Systems, was transferred to Delphi in 1997. The one constant in GM's history has been perpetual restructuring, to enable it to survive in periods of crisis and to prosper in periods of growth. Thus, any outline of GM's main parts-making operations

must always be regarded as a snapshot of a constantly changing process (Fig. 3.4).

Companies forming the nucleus of the Energy and Steering Divisions became part of GM shortly after its founding in 1908. The core of the Chassis, Thermal, and Interior Divisions was added during the 1910s, the Electronics Division during the 1920s, and the Electric Division during the 1930s.

The founder of General Motors, William C. Durant, was responsible for acquiring most of the parts-making operations. Billy Durant, as he was



3.4. Delphi Automotive Systems, origin of major divisions as part of General Motors. Dashed lines represent units making only nonautomotive parts. (Adapted by the author from multiple sources)

known, is dimly recalled inside the auto industry and virtually unknown outside. Henry Ford and Walter P. Chrysler gave their own names to their companies, but Durant's name appears on no automotive nameplate or corporation. The only visible remembrances of Durant are the initial *D* carved into the stones of GM's longtime headquarters on West Grand Boulevard in Detroit, and a life-size statue in Flint dedicated on his one hundred twenty-seventh birthday, December 8, 1988.

In the eyes of automotive historian Arthur Pound, Durant was "the greatest promoter America has ever seen in action. General Motors is today the largest American corporation . . . [as] the result of the promoting ability of a single individual."[17] Fellow car maker Walter P. Chrysler said of him, "I cannot hope to find words to express the charm of the man. He has the most winning personality of anyone I've ever known. He could coax a bird right down out of a tree."[18] Yet Durant died in poverty and obscurity, his personality and business methods a source of deep embarrassment to future GM executives.

Durant cared little about money for its own sake. His own tastes were said to be simple: "he had no time to spend money." He was quiet and soft-spoken, a devoted family man who rarely drank and who placed a "Please Do Not Smoke" sign on his office wall in an era when smoking was extremely popular. According to Pound, "he worked more hours than any of his employees, did with little sleep, yet came to his labors fresh and smiling every morning."[19]

Before starting General Motors in 1908, Durant headed Durant-Dort Carriage Company, the country's largest carriage maker. Durant-Dort went further than its competitors in making carriage components, including wheels, paint, varnish, and axles, and it had extensive timber holdings. Durant recalled, "My twenty years' experience in the carriage business taught me a lesson. We started out as assemblers with no advantage over our competitors. We paid about the same prices for everything we purchased. We realized that we were making no progress and would not unless and until we manufactured practically every important part that we used." Durant recalled how he "proceeded to purchase plants and the control of plants, which made it possible for us to build up from the standpoint of volume the largest carriage company in the United States."[20]

Durant applied the same logic to the automotive industry. "Controlling this enormous volume would make it possible for these accessory plants . . . to materially reduce costs because of the volume of business from GM

which they could depend upon if motor cars and motor trucks, as I was firmly convinced, was [*sic*] to become important factors in the industrial life of America."[21]

Durant was not selective in the parts makers he bought. In the words of one chronicler of the industry, "nobody at the time knew what would work best—what types of motors, gear, axles, magnetos, wheels, springs, radiators would become permanent or practical and useful. Everybody in the business was experimenting."[22] Durant made some unsuccessful purchases, such as Dow Rim Company and Heany Lamp Companies, the latter a collection of firms with "what charitably may be described as a clutch of clouded patents on the tungsten-filament electric light."[23] But Durant's success rate was high, and his acquisitions turned GM into the world's largest parts maker.

Delphi Energy and Engine Management Systems

The origins of Delphi's engine division go back to 1908, when Durant turned his legendary charm on Albert Champion. Durant recalled that he was in Boston, getting a Buick salesroom in order, when Albert Champion walked in and showed him "a very neat gadget which had much merit. It was not suited to the Buick because at that time the Buick was not a four-cylinder car. The gadget was well designed and showed good taste. I thought that anyone who could produce that kind of a device might do other worth-while things as well."

"Have you a factory?" Durant recalled asking.

"No, just a shop."

"What are you making?"

"Magnetoes and spark plugs." (A magneto was a type of alternator with permanent magnets used to generate current for the ignition in an internal combustion engine.)

"We do not use magnetoes, but I am interested in spark plugs. Can you make a good one?"

"I have just started in that line," Champion replied, "but I worked for a number of years with Mr. Renault of Paris, France, and am following his methods which have been most successful."[24]

Durant bought the Champion Ignition Company for $2,000 and enticed Champion to move to Flint, where GM's headquarters was located. When the company's owner, a man named Stranahan, refused to sell the rights to the name of Champion Ignition Company, Durant told Champion he was

interested in the spark plugs, not the name, but Champion replied, "I am very much interested in the name. That is my name." They settled on his initials instead, and the company became AC Spark Plug Company.

Two other GM acquisitions—Rochester Products and Delco-Remy—also contributed to the formation of Delphi Engine. Rochester Products built a variety of engine control components, including valves, fuel line components, and carburetors. When it first opened in 1939, the Rochester plant built an even greater variety of components, such as instrument panels, speedometers, generators, starters, electric horns, hydraulic brakes, ignition distributors, and shock absorbers, primarily to ship to GM's final-assembly plants in the Northeast.

Durant bought Remy Electric Company, of Anderson, Indiana, in 1916. B. P. and Frank Remy had founded the company in 1901 to make ignition equipment for stationary and marine engines, including electric dynamos, magnetos, and oscillators. A Remy high-tension magneto, introduced in 1904, was used on several early cars. The Remys sold the business in 1911 to an Indianapolis banker, Stoughton Fletcher, who in turn sold it to Durant. Lovell-McConnell Manufacturing Company, another electrical company bought by Durant, made marine equipment, notably an electrically operated sound-signal device. The horn, later built for cars, was sold under a patented trade name, Klaxon, from the Greek verb "to roar or to shriek." Early motorists used the name Klaxon as a generic term for the car horn, much as consumers have done with other trademark names, such as Kleenex, Xerox, and Scotch tape.

The Klaxon plant in Newark, New Jersey, was closed, and production was transferred to Remy in 1926. Production of ignition equipment was also transferred that year from Delco in Dayton to Remy, which was renamed Delco-Remy. Delco-Remy joined AC Rochester in 1992 to form AC Delco Division, renamed Delphi Engine and Engine Management Systems Division in 1994.

Delphi Steering Systems

Several other early Durant acquisitions eventually formed the Delphi Steering Systems Division. One was Jackson-Church-Wilcox Company, organized in Saginaw in 1908 by the three men who gave their names to the company. The firm obtained control of a British patent for a half-nut gear with double-thread screw, which it produced for Buick under the brand name of Jacox. When its rapidly expanding demand for steering gears could not be met, Buick bought Jacox in 1910. Durant combined Jacox with

other Saginaw-area acquisitions in 1919 to form the Saginaw Products Division.

A second Durant acquisition in Saginaw, the Motor plant, produced overhead valve motors for four-cylinder Chevrolets and Oldsmobiles beginning in 1919. GM had acquired the plant in 1908 from the Rainier Motor Company and used it for three years to produce cars called Marquette. The plant then sat idle until 1917, when it produced trench-mortar shells during World War I.

Durant's subsequent Saginaw acquisitions included National Engineering Company, which made crankshafts for Reo beginning in 1907 and for GM's Northway division starting in 1913, and Saginaw Malleable Iron Company, which supplied malleable castings. Another Saginaw plant, the Gray Iron Foundry, was built in 1919 to assure a supply of gray iron castings for motors.

After two years of buying as many companies as he could for General Motors, Durant ran out of cash in 1910 and lost control of the company. Durant had expanded GM to maximize the company's stock price, which in turn would finance expansion and reward his many friends who had invested in the company.[25] But his bubble burst in 1910, when a recession caused car sales to decline. To save GM from going into receivership, bankers took control of the company from Durant. Bankers appointed to GM's board of directors arranged a $2.25 million loan to rescue the company, at terms extremely favorable to their banks.

Durant later told a story to illustrate the haphazard approach by which he had acquired so many parts makers in the first two years of GM's existence.

> The early history [of GM] reminds me of the following story: General Wheeler, who came up from the ranks, met Major Bloomfield, a West Pointer, at the Chickamauga battlefield at Chattanooga. In speaking of the engagement, General Wheeler said to Major Bloomfield, "right up on that hill there is where a company of infantry captured a troop of cavalry." Major Bloomfield said, "Why General, you know that couldn't be, infantry cannot capture cavalry." To which General Wheeler replied, "But you see, this infantry captain didn't have the disadvantage of a West Point education and he didn't know he couldn't do it, so he just went ahead and did it anyway."[26]

After Durant's departure, the components of the Saginaw Products Division were split apart again in 1928, when geographic proximity was considered less important than functional relations. Jacox became the Saginaw Steering Gear Division, later Saginaw Division, then Delphi Saginaw

Steering Systems. Saginaw Malleable Iron became a separate division until it was transferred to the newly created Central Foundry Division in 1955. The Gray Iron plant went to Chevrolet, later to Central Foundry. National Engineering became Saginaw Crankshaft Division until 1931, when it was disbanded and the functions transferred to Chevrolet's transmission division. The Motor plant closed in 1923 when GM stopped producing four-cylinder engines. The Saginaw Division was renamed Delphi Saginaw Steering Systems Division in 1992 and Delphi Steering Systems in 1999.

Delphi Chassis Systems

Having lost control of General Motors in 1910, Durant established two new automotive firms: Republic Motors to assemble cars, including Chevrolet (see chapter 7), and United Motors to make parts. Two Delphi divisions—Chassis Systems and Harrison Thermal Systems—were put together by Durant not for General Motors but for United Motors.

Delphi Chassis emerged from three companies that became part of United Motors during the 1910s: Hyatt Roller Bearing Company, New Departure Manufacturing Company, and Dayton Engineering Laboratories Company. The Hyatt Roller Bearing Company was founded in 1892 by John Wesley Hyatt to produce roller bearings, which he had invented four years earlier for crushing sugarcane. The bearings consisted of three elements: an inner shell, a cage containing hollow cylindrical rollers, and an outer shell.

The New Departure Bell Company was organized in 1888 to make push-button doorbells, then thumb-operated rotary bells and hand brakes for bicycles. In 1907 the company developed ball bearings, consisting of four principal parts: an inner race or shell, an outer race, separator, and steel balls. New Departure was combined with Hyatt in 1965 to form New Departure Hyatt Division.

The Dayton Engineering Laboratories Company was founded by Edward A. Deeds and Charles F. Kettering to make the first practical self-starter for automobiles. The importance of the self-starter to the development of the auto market cannot be underestimated. As one early chronicler of the industry observed, "more than any other single thing, the development of the electric self-starter served to extend the automobile's scope of usefulness as a family vehicle."[27] Before the invention of the self-starter, starting an engine required "the strength of Ajax, the cunning of Ulysses and the speed of Hermes." The reason: "Ulysses had to adjust the spark and throttle just so; Ajax had to turn the engine over, sometimes over and over; and Hermes had

to dart back like a flash to the controls to advance the spark and regulate the gas before the engine went dead again."[28]

The death of Byron T. Carter, who had recently sold Cartercar to GM, hastened the introduction of the self-starter. Carter stopped on a cold December day in 1910 to aid a woman whose car had stalled on an approach to a bridge to Detroit's Belle Isle Park. She was unable to restart her car because—in the vivid words of Arthur Pound—"the whole back-breaking operation [of starting a car] was quite beyond the powers of all women save those of Amazonian proportions."[29] When Carter spun the crank to turn over the flywheel, the motor backfired (a common occurrence), throwing the crank suddenly into reverse. The force of the backlash snapped Carter's forearm and smashed his jaw. He was taken to a hospital, where he developed pneumonia and died.

Henry Leland, a friend of Carter, vowed to install a self-starter on Cadillac, but his engineers were unable to produce a practical one. Other auto industry firms that had been trying for some time to produce a self-starter also failed in their quest. Cadillac's assistant sales manager Earl Howard told Leland that when he was working at National Cash Register Company (NCR) in Dayton, Ohio, a few years earlier, he had seen a young engineer there, named Charles F. Kettering, invent an electric motor to replace the hand crank on cash registers. Leland contracted with Kettering and his partner Charles F. Deeds to apply the technology to a self-starter for motor vehicles.

Kettering and Deeds began to manufacture self-starters for Cadillac in 1911, in a disused barn behind Deeds's home in Dayton, staffed mostly with NCR moonlighters. The name Dayton Engineering Laboratories Company was soon shortened to Delco, and the company moved into larger facilities in Dayton. In 1919 Durant also acquired Kettering and Deeds's Dayton Metal Products Company and its offshoot, the Dayton-Wright Airplane Company, which had turned out a large number of airplanes for the U.S. government during World War I. (The Wright Brothers were natives of Dayton and had done all their research, development, and manufacturing in that city before taking their plane to Kitty Hawk, North Carolina, for testing.)

GM reorganized Delco's laboratories into the General Motors Research Corporation in 1920, and moved them from Dayton to new facilities in Detroit in 1925. Kettering, universally called "Boss" Kettering, moved to Detroit as GM's first director of research. The Research Corporation was converted into the Research Section of General Motors during the 1930s.

As director of research Kettering constantly moved new products into the Dayton plants, while moving mature products out to other GM plants. When production of ignition equipment was consolidated at the Delco-Remy plant in Anderson, Indiana, the Delco plant in Dayton—renamed Delco Products Corporation—made shock absorbers, struts, and other chassis components instead. From Delco Products, Kettering spun off Moraine Products to make Durex self-lubricating bearings and Moraine rolled bronze bearings, and Delco Brake to manufacture brakes.

Delco Brake and Moraine Products were merged in 1943 into the Delco-Moraine Division, which in turn joined with New Departure Hyatt in 1989 to form the Delco Moraine NDH division. Delco Moraine NDH was combined with Delco Products in 1990 to form Delco Chassis, which was renamed Delphi Chassis Systems in 1994.

Delphi Harrison Thermal Systems

Delphi Harrison Thermal Systems also originated from several companies Durant acquired for United Motors. Herbert H. Harrison founded Harrison Radiator Company in Lockport, New York, in 1910, to address a major early problem with automobiles, the tendency of engines to overheat. Harrison patented a cellular or honeycomb-shaped radiator called the Harrison Hexagon. United Motors acquired Harrison in 1918 as a result of a contact between Alfred P. Sloan, then president of United, and Harrison's vice president and treasurer B. V. Covert. As head of Hyatt, Sloan had sold roller bearings to Covert Gear Company, which made bicycle gears.

United Motors also acquired Guardian Frigerator Company from Murray Body Company, a large manufacturer of automotive bodies, and turned over its assets to its Delco-Light Division, which made electric generators for rural homes. Delco-Light production was transferred in 1930 from Dayton to the North East Electric Company in Rochester, New York, which GM had acquired a year earlier. North East was renamed Delco Appliance Corporation.

Guardian was attempting to build electric iceboxes, which Durant called "the greatest thing that could be put on the market, next to the automobile."[30] He renamed the iceboxes Frigidaire. Several decades later Frigidaire was a pioneer in developing automotive air conditioning, in addition to its principal product of refrigerators for kitchens. When GM sold off Frigidaire in 1981, it retained production of air conditioners for motor vehicles and assigned that function to the Harrison Division.

While acquiring companies for United Motors, Durant kept close

watch on the fortunes of General Motors. Under the bankers, GM's financial position stabilized. They sold several of Durant's unprofitable acquisitions, including Seager Engine, Welch-Detroit, Michigan Auto Parts, National Motor Cab, and Ewing. Newly appointed division heads and plant managers corrected inefficient management practices, such as maintaining large inventories of faulty parts and materials, permitting machines to rust by leaving them outside, and damaging tires and other parts through exposure to heat and sunlight. Standardized accounting and reporting systems were adopted. To restore public confidence in its financial statements, in 1911 GM became the first auto company to be listed on the New York Stock Exchange.[31]

GM's earnings soared, but stockholders were unhappy because the bankers were content to collect interest on the 1910 loan instead of paying dividends. Durant—the most charming man on the face of the earth—convinced enough unhappy stockholders to trade GM shares for five shares of Chevrolet that he regained control of GM in 1915 (see chapter 7). Durant reset GM's course back to his original vision of expansion through vertical integration. With the addition of United Motors in 1918, GM became the world's largest parts maker, the basis for becoming the world's largest manufacturer.[32]

Delphi Interior Systems

Delphi Interior Systems merged three GM divisions with disparate histories: Fisher Body Corporation, Guide Lamp Corporation, and Inland Manufacturing. Fisher and Guide were combined in 1986 to form Fisher Guide Division, which in turn joined with Inland to form Inland Fisher Guide in 1990. The division was renamed Delphi Interior and Lighting Systems in 1994, then Delphi Interior Systems in 1999.

The Fisher acquisition moved General Motors into the last major element of parts making it did not yet control—the body. As was typical, GM bought an existing company, while Ford set up its own body-making operations, thereby forcing its major supplier, C. R. Wilson Body Company, out of business. Fred J. and Charles T. Fisher, sons of an Ohio carriage and wagon maker, had worked for Wilson in Detroit before setting up their own company in 1908. Fisher Body Corporation was the first large-scale manufacturer of closed bodies, which it supplied to Cadillac. Fisher correctly anticipated that the closed body would soon replace the open, carriage-style bodies of the day. On the strength of its closed bodies, Fisher became the largest body maker.

Durant acquired a three-fifths interests in the Fisher Body Corporation for GM in 1919, leaving the Fisher brothers in charge of day-to-day management. GM acquired the remaining 40 percent of Fisher Body in 1926. Fisher was still selling bodies to other companies, including Chrysler, and was reluctant to increase capacity, even though GM wanted a body plant next to every assembly plant around the country.[33]

In 1928 GM bought Guide Lamp Corporation, which was founded in 1906 initially to repair lamps for cars, and then, four years later, to manufacture them. Guide later took over one of Durant's first acquisitions, a purchase made back in 1908—Brown-Lipe-Chapin Company, which made differential gears, later die castings, radiator emblems, bumper guards, and hub caps.

Inland Manufacturing, originally part of the Dayton-Wright Company, joined GM in 1921 to make steering wheels. A decade later, anticipating the demise of wood products, Inland began to make steering wheels and other parts from rubber.

A sudden slump in the nation's economy in 1920 caught General Motors with a large inventory of unsold cars for which demand had temporarily dried up. With GM's share prices falling, Durant stepped in and started to buy large numbers of shares, as always on margin, including shares that his skittish friends wished to unload. He stemmed the decline temporarily, but eventually ran out of cash and credit. Again bankers bailed out GM, this time J. P. Morgan & Company. With his personal debts threatening the company's financial stability, Durant resigned as president in 1920. Leaving his office for the last time, Durant is said to have "put on his hat with something of a flourish, [saying] 'Well, it's moving day.'"[34]

Leaving forever the corporation he had founded twelve years earlier, Durant was nowhere near finished in the motor vehicle industry. He launched yet another car company in 1926, at age sixty-six, this time naming the company for himself. Within a year Durant Motors had $31 million in orders, and was said to be worth $50 million. Especially successful was Durant's low-priced Star, which had been deliberately named to appeal to buyers offended by Henry Ford's anti-Semitism. The 1929 stock market crash wiped out Durant. Durant Motors went out of business in 1933, and Durant himself filed for bankruptcy in 1936. He died in 1947, at age eighty-six, living the last three years of his life in "shabby dignity" with his wife, in an apartment in the Gramercy Park neighborhood of Manhattan, supported quietly by GM officials.[35]

For all his haphazard organization, Durant was the first auto executive to articulate a clear rationale for vertical integration. Durant recalled in his undated memoirs that Durant-Dort had become the country's largest carriage manufacturer back in the nineteenth century through vertical integration. "We started out as assemblers with no advantage over our competitors. We paid about the same prices for everything we purchased. We realized that we were making no progress and would not unless and until we manufactured practically every part that we used."[36]

Delphi Packard Electric Systems

Control of GM passed to E. I. du Pont de Nemours & Company, which had first invested heavily in GM in 1915 at Durant's urging, and increased its GM holdings to 38 percent in 1920. Pierre S. du Pont, president of the chemical company, was president of GM (1920–23) and chairman of the board (1915–29); in 1929 he was succeeded by his son Lammot. DuPont treasurer John J. Raskob chaired GM's powerful Finance Committee, and other du Pont family members and company executives dominated GM's management and board.

DuPont, which controlled three-fourths of the U.S. explosives market in 1907, was successfully sued for antitrust violation by the U.S. government; in 1912 du Pont was forced to split off its Atlas and Hercules powder companies. World War I bolstered du Pont's armaments sales—the company made 40 percent of the artillery shells fired during the war—but with the war over, du Pont looked to the booming auto industry as a customer for its paint, dyes, and other new chemical products.

DuPont quickly reaped the benefits of its control of GM. Ford's Model T was offered only in black because other colors of paint took much longer to dry. GM passed Ford in sales during the 1920s in large measure by applying fast-drying paint in rich, deep colors.

DuPont was again charged with antitrust violations, in 1949, because its control of the world's largest corporation stifled competition among automotive suppliers. After a year-long trial, the U.S. District Court ruled in 1954 in favor of du Pont, but the U.S. Supreme Court reversed the decision in 1957. The Supreme Court found that "there is overwhelming inference that DuPont's commanding position [as a GM customer] was promoted by its stock interest and was not gained solely on competitive merit. . . . DuPont purposely employed its stock to pry open the General Motors market to entrench itself as the primary supplier of General Motors' requirements

for automotive finishes and fabrics."[37] Sixteen years after charges were initially filed, in 1965, the du Ponts and their corporation were finally forced to sell their GM shares.

The principal architect of GM's organization into a modern corporation was Alfred P. Sloan, who had been general manager and then owner of Hyatt Roller Bearings when that company was acquired by Durant. Impressed with Sloan, Pierre du Pont promoted him to vice president and groomed him to become his successor as GM president in 1923. Sloan was president of GM until 1937, then served as chairman of the board until 1956. Under Sloan's leadership, GM extended its parts-making activities into the rapidly growing area of electrical components.

It was during Sloan's presidency that GM bought Packard Electric Company in 1932. Packard Electric Company was established in Warren, Ohio, by J. W. and W. D. Packard in 1890 to manufacture incandescent lamps and transformers. The company introduced the luxury Packard automobile in 1898. In 1903 the family sold the car-making operations to Henry Joy, who moved production to Detroit. During its five years of producing cars, Packard had difficulty purchasing cables that met its standards, so it began to make its own. The business grew as cars added more electrical equipment, such as ignition, lighting, and radio. By 1932 its attraction for GM was clear.

Delphi Delco Electronics

Delphi's seventh division, Delco Electronics, joined GM in 1936, when the company acquired a radio factory in Kokomo, Indiana, from the Crosley Manufacturing Company. The plant was turned over to the newly created Delco Radio Division, originally a joint venture with radio pioneers RCA, GE, and Westinghouse. The company was renamed Delco Electronics Corporation after World War II. In 1985 it became a subsidiary of GM Hughes Electronics Corporation, along with Hughes Aircraft Company, acquired from the Howard Hughes Medical Institute. When GM turned Hughes back into an independent company in 1999, Delco Electronics was transferred to Delphi.

Independence for Ford and GM Parts Divisions

General Motors and Ford reached vertical integration in different ways, but they took remarkably similar routes in the 1990s away from vertical integration. Both created wholly owned subsidiaries to manage their many

parts-making operations, then converted the subsidiaries into independent companies, Delphi and Visteon, respectively.

When GM and Ford made most of their own parts in-house, they were the two largest parts makers in the world. But because most of those parts were destined for other divisions within the same companies, earnings, sales, and profits were meaningless concepts. Under Sloan, GM tried to measure the performance of each parts division through an accounting procedure that isolated each as if it were a self-contained business, with its own revenues and expenses. However, the approach still did not produce meaningful financial information about the parts-making operations, because of the difficulty of deciding how to value transfers between divisions. In principle, GM used market pricing, but given the company's dominant position, finding a market price was not always possible. In reality, transfer pricing was based on a variety of historical and circumstantial situations. For example, GM vehicle divisions transferred to Fisher cost plus 17.6 percent for bodies, because that was the amount specified in the original contract when GM bought 60 percent of the company in 1919.[38]

As independently controlled entities competing with independently owned suppliers, the parts operations would be forced to set market prices and be fully accountable to investors. Sheltered from competition, the parts operations of Ford and GM were widely reckoned to be inefficient money losers. But Wall Street was surprised in 1997, when Delphi and Visteon both released financial statements. Delphi had earned 3.3 percent return on investment, and Visteon, 3 percent—only slightly below the industry average of 5 percent.

GM ACG becomes Delphi

General Motors took a look at the performance of every one of its parts plant during the 1980s, classifying them into three groups: currently profitable, currently unprofitable but could become profitable, and hopelessly unprofitable. Using a traffic-light analogy, the currently profitable plants were termed "green," the salvageable plants "yellow," and the hopeless plants "red." More than fifty GM parts plants destined to be part of Delphi were judged "yellow" or "red" in 1992. GM set a goal of eliminating all unprofitable plants, whether by fixing, selling, or closing them. Parts plants were sold to six other companies during the 1990s:

- Saginaw Steering gear and axle plants in Detroit and Buffalo, and forges in Detroit and in Tonawanda, New York, were sold in 1994 to American

Axle and Manufacturing (AAM), headed by former Chrysler executive Richard Dauch. AAM was the twelfth-largest parts supplier in 2001, with $3 billion in sales.

• A Delco Remy starter motor plant in Anderson, Indiana, was sold in 1994 to DelcoRemy America, Inc. In addition to original equipment starter motors, DelcoRemy also remanufactured and supplied auto parts stores with motors, alternators, and other parts. The company was the seventy-third-largest supplier of new-vehicle parts in 2001, with North American original equipment sales of $600 million.

• Four Delphi Interior Systems plants in Flint and Livonia, Michigan, and Oshawa and Windsor, Ontario, were sold in 1996 to Peregrine, Inc., created by Joseph Littlejohn & Levy, a New York buyout-fund manager. Plants in Battle Creek, Jackson, and Warren, Michigan, and Matamoros, Mexico, were added in 1997 through acquisition of MSI Manufacturing. Peregrine was the thirty-fifth-largest supplier in 1999, with North American sales of nearly $1 billion. The company ran into financial trouble, which it blamed on inheriting from GM obsolete factories and an uncompetitively high wage structure for manufacturing low-tech components readily available from lower cost, nonunion competitors. The Flint and Livonia plants were closed, and the remainder sold to Lear Corporation in 1999. Lear was the third-largest supplier in 2001, with sales exceeding $8 billion.

• Delphi Lighting plants in Anderson, Indiana, and Monroe, Louisiana, were sold in 1998 to Guide Corporation, created by Palladium Equity Partners L.L.C., a New York leveraged-buyout fund management firm. At the time of its spinoff, Guide made headlamps, turn signals, tail lamps, and license plate lamps solely for GM. GM guaranteed that it would continue to buy Guide's lamps for five years. The company was the seventy-seventh-largest supplier of new-vehicle parts in 2001, with North American original equipment sales of $500 million. Almost entirely dependent on sales to GM, Guide, too, ran into financial difficulty in 2000, when GM demanded price reductions on the lights that Guide was already selling to it at a loss.

• Delphi Interior's seating plants in Auburn Hills, Grand Rapids, and Warren, Michigan, as well as several foreign plants, were sold to Lear Corporation in 1998.

• Delphi Chassis's coil-springs plant in Livonia, Michigan, was sold in 1998

to Chasco Systems, Inc., owned by the Walter Johnson Group, Inc., a Dallas-based, minority-owned firm that also owned real estate and securities.

Delphi officially became an independent company in 1999, when it sold some shares to the public, then turned over the rest to GM shareholders. As GM parts contracts expired, Delphi retained the business as long as it matched competitors' prices, technology, and quality, until January 1, 2002. After that date, GM would treat Delphi on an equal basis with other suppliers.[39]

As an independent company, Delphi became the world's largest parts maker, with worldwide sales of $27 billion ($21 billion in North America). GM initially accounted for more than 80 percent of Delphi's worldwide sales, but within a year dropped to 70 percent, with DCX, Renault, Toyota, and Volkswagen buying most of the remainder. Even excluding sales to GM, Delphi would still rank as one of the country's top five suppliers.

Ford APO Becomes Visteon

Ford emulated GM's model of placing parts plants in many locations after World War II. During the 1950s stamping plants were opened in Buffalo, Chicago, Monroe (Michigan), and Walton Hills (Ohio); transmission plants in Cincinnati and Livonia; an axle plant in Sterling Heights, Michigan; a steering gear plant in Indianapolis; and engine plants in Cleveland and Lima, Ohio. When Ford's Automotive Parts Operations (APO) was turned into Visteon in 1997, parts plants were allocated to seven units:

- The Chassis Division made power steering pumps in Indianapolis, wheels and springs in Monroe, and axles in Sterling Heights.
- The Climate Control Division made radiators and condensers in Connersville, Indiana, and heating and air conditioning components in Plymouth, Michigan.
- The Electronics Division made sensors in Colorado Springs.
- The Exterior Division made bumper fascias and fuel tanks in Milan, Michigan, and exterior lighting, air handling, and fuel vapor systems in Sandusky, Ohio.
- The Glass Division made windshields and windows at Dearborn, Tulsa, Oklahoma, and Nashville, Tennessee.
- The Interior Division made instrument panels at Saline, Michigan, door

trim and headliners at Utica, Michigan, and foam pads and seat covers at Mount Clemens, Michigan.

- The Powertrain Division made fuel senders and delivery modules at Bedford, Indiana, fuel injectors at Rawsonville, Michigan, starter motors at Ypsilanti, Michigan, and electronic engine control systems at Lansdale, Pennsylvania.

Until the 1990s, Ford had organized its parts plants into three groups of operations: body and assembly operations, including stamping and trim plants, as well as final-assembly plants; powertrain and chassis operations, divided into the Engine Division and the Transmission and Chassis Division; and diversified products operations (DPO), divided into five parts-making divisions (casting, climate control, electrical and electronics, glass, and plastic) plus Rouge Steel, aerospace, and tractor. Climate control, plastic, and some electronics plants were combined in 1994 into the Automotive Components Division, and DPO was renamed Automotive Products Operations.

Visteon got the Chesterfield, Utica, and Monroe plants from the body and assembly operations, and the Indianapolis and Sterling plants from the Transmission and Chassis Division of the powertrain and chassis operations. DPO's casting operations were turned over to the powertrain operations. Like GM, Ford had first tried to get rid of some parts plants. A seat plant in Mexico was sold to Lear Corporation in 1995, and the glass plants were put up for sale, but when no one was interested in buying them, they became part of Visteon.[40]

When created, Visteon was tied more closely to Ford than Delphi was to GM. Only one-tenth of Visteon's sales were to customers other than Ford, although that amounted to more than $1 billion in sales, which would have ranked it as the twenty-fifth-largest supplier.[41] Visteon hoped to sell one-fifth of its parts to outsiders. The new name was designed to help build trust that Ford's parts operations would act independently of Ford's automotive operations.

In most respects, Visteon is very different from Henry Ford's parts-making complex, but the Rouge was not exactly abandoned. Most of the Rouge's large buildings remain, though many smaller ones have been removed. Employment at the Rouge declined from 110,000 in 1929 to 40,000 in 1957 and 10,000 in 2000. The steel-making operation became a subsidiary of the Ford Motor Company, then was sold in 1989 to Marico Acquisition Company, which in turn created an independent company, Rouge

Steel Company, owned by a holding company, Rouge Industries, Inc.[42] Ford and then Visteon tried and failed repeatedly during the 1990s to sell the glass operations. Still, the Rouge's six basic functions remain: raw materials are still shipped in, power is still generated, engines are still cast, steel is still stamped, glass is still made, and vehicles are still assembled.

Most important, Ford began a $2 billion project in 2000 to make the Rouge complex more environmentally friendly. The old assembly plant was to be demolished and replaced with a modern plant that included the world's largest "living" rooftop, a 450,000-square-foot area covered with soil and plants. Contaminated land no longer needed for production, such as the site of the former coke ovens, would be replaced with vegetation. The River Rouge would be cleaned and restored to its natural course to protect fish. The Ford family hoped that an environmentally sensitive Rouge would become as important a symbol of corporate priorities in the twenty-first century as it had been in the twentieth.[43]

4 . . . To Buying Parts

Historically, mechanical engineers controlled the destiny of the vehicle. Now it is the electrical engineer.

—Martin Anderson, director of Supply Chain Programs, Babson College

Douglas & Lomason Company was the forty-first-largest U.S. automotive parts producer in 1994, selling more than $500 million worth of parts for installation in new U.S. motor vehicles that year. The company was listed on the NASDAQ exchange, and its 5,800 employees made seats and decorative trim for Chrysler, Ford, and Mitsubishi. The fate of Douglas & Lomason illustrates the changing relationship between major suppliers of components and motor vehicle manufacturers in the late twentieth century.

Like many suppliers, Douglas & Lomason was a long-established company that had made other products before entering the motor vehicle industry. Founded in 1902 in Detroit to make carriage rails for horse-drawn vehicles, Douglas & Lomason supplied its first component to the motor vehicle industry in 1905: a brass rail guard to keep passengers from falling out of their seats. Running boards and windshields were added in 1912. When running boards disappeared from cars in the late 1930s, Douglas & Lomason started making metal trim and ornaments.

Until the 1980s Douglas & Lomason followed the standard mass production practice of each year submitting bids to the vertically integrated U.S. vehicle manufacturers to make individual parts for them. The company received contracts when it submitted the lowest price. To remain competitive, Douglas & Lomason reduced manufacturing costs by relocating its trim and ornament production from Detroit to the Southeast, where labor costs were lower. It opened two trim plants in Georgia in 1955, one in Mississippi in 1964, and one in Alabama in 1970. One of the two

Georgia plants was closed in 1990, two years after a replacement was opened elsewhere in that state.

While moving nearly all of its trim operations to the Southeast, in 1955 Douglas & Lomason began to use its old Detroit plant to make metal seat frames. In those days, motor vehicle producers purchased the various parts for making seats from different suppliers and put the seats together during the final-assembly operations. Douglas & Lomason expanded its seat frame business, adding a plant in Arkansas in 1960 and one in Nebraska in 1965. It offered a second seat component in 1973, polyurethane foam for seating pads, produced in St. Louis.

Relationships between motor vehicle manufacturers and suppliers such as Douglas & Lomason changed dramatically during the 1980s in reaction to the economic downturn of the 1970s. Douglas & Lomason's initial reaction to the economic downturn was to close the old Detroit plant in 1976 and move corporate offices to the Detroit suburb of Farmington Hills. The St. Louis plant was also closed in 1976, and foam production was relocated to a new plant in Tennessee.

More substantial restructuring took several years to achieve. To retain its contracts with vertically disintegrated car makers, Douglas & Lomason had to start supplying complete seats instead of only steel frames and foam. The company would have to either manufacture seat covers, trim, springs, and controls, as well as frames and foam pads, or purchase them from other suppliers. And under lean production, the seats had to be delivered to the final-assembly plants on a just-in-time basis—that is, within minutes of installation in the assembly process.

As it was taking on more responsibility for producing entire seat modules, Douglas & Lomason also had to start conducting research into consumer preferences for more complex seats, with such features as electronic repositioning controls, heaters, and child protection devices. Lean production required the company to respond quickly to changing consumer preferences.

Douglas & Lomason expanded its production capacity in 1983 by converting an existing plant in Iowa to assembly of seats for Chrysler's newly introduced minivan. Armed with the security of long-term contracts for seat modules, Douglas & Lomason built several new factories near final-assembly plants to meet the demand for just-in-time delivery. New factories were opened in 1988 in Richmond, Michigan, and in Havre de Grace, Maryland (near Chrysler's Newark, Delaware, final-assembly plant). After

landing a long-term contract in 1993 to supply seat modules for Ford's new Contour and Mystique models, Douglas & Lomason built another new plant in Excelsior Springs, Missouri, near Kansas City, where the Contour and Mystique would be assembled beginning in 1995. At the same time, however, Douglas & Lomason closed its Michigan seat assembly plant because it no longer had long-term contracts for seat modules from nearby assembly plants.

In 1988 Douglas & Lomason recognized the growing globalization of the auto industry by forming a joint venture with Namba Press Works of Japan, called Bloomington-Normal Seating Company. In 1988 the company built a plant in Normal, Illinois, to supply seat modules to the nearby final-assembly plant operated by Diamond-Star Motors Corporation, then a joint venture between Mitsubishi and Chrysler.

Because it could not afford to build new factories near all of their customers, Douglas and Lomason leased warehouses in Troy, Missouri, in 1990, and in Orangeville, Ontario, in 1992. Seat modules produced at the company's factories were stored in these warehouses until needed on a just-in-time basis at nearby final-assembly plants. By demanding seats on a just-in-time basis, the motor vehicle producers essentially passed inventory costs to the suppliers.

Burdened with the financial demands of new product development and just-in-time delivery, Douglas & Lomason looked for ways to reduce production costs without sacrificing quality. Accordingly, it relocated some production to Mexico, to take advantage of the much lower wages there. A plant was opened in 1987 in Ciudad Acuna to cut and sew soft trim components; a second Mexican plant, opened in 1992 in Saltillo, made seat frames. Because just-in-time delivery from Mexico was difficult, the company did not assemble complete seat modules there. Instead, the Mexican-made components were warehoused across the border in Del Rio, Texas, then shipped to the company's seat assembly plants closer to the motor vehicle manufacturers' final-assembly plants. Growth was limited in Mexico because materials rather than labor constituted most of the company's production costs. Most of the company's cost savings resulted from substituting lower cost materials and designing lighter weight individual parts.

Despite its massive restructuring efforts, Douglas & Lomason could not keep pace with industry changes toward vertical disintegration and optimum lean production. The two leading seat makers, Lear Corporation and Johnson Controls, Inc., which held about one-third of the U.S. seat market each in the 1990s, acquired other parts makers to give them the capability

of building entire interiors. Among Lear's acquisitions was the third-largest seat maker, GM's Delphi Automotive Systems, with one-sixth of the market. Lear's and Johnson's combined annual sales of automotive components in North America jumped in just eight years from $2.5 billion in 1992 to $16 billion in 2000.

In fifth place with one-tenth of the seat market and $500 million in sales, Douglas & Lomason was swamped by its much larger competitors. It posted a return on equity of 10 percent in 1994, compared to 20 percent for Lear and 14 percent for Johnson Controls. The fatal blow came in 1995, when Chrysler, which had accounted for nearly half of Douglas & Lomason's automotive components business, dropped it as a supplier in favor of the much larger Johnson Controls and Lear. Douglas & Lomason closed four facilities, but even so the company couldn't remain independent. It was sold in 1996 to Magna International, Inc., then the fourth-largest seat maker. Magna, like Lear and Johnson Controls, went on a buying binge to enhance its ability to deliver complete interiors, and its North American parts sales grew from $2.3 billion in 1992 to $7 billion in 2000.

Douglas & Lomason's story has been repeated throughout the motor vehicle industry. Longstanding relationships between suppliers and manufacturers changed under lean production, especially during the 1980s. In reaction, suppliers grew bigger or went out of business during the 1990s. By the turn of the century, under optimum lean production, motor vehicle manufacturers depended on a smaller number of very large suppliers capable of producing large portions of their vehicles.

Consolidation of Suppliers

Two kinds of companies produce motor vehicle parts. A company making parts sold primarily as replacements in older vehicles is an *aftermarket supplier*. A company making parts primarily destined for installation in new vehicles is called an o*riginal equipment manufacturer* (OEM). An OEM is known as a tier one supplier if it sells parts primarily to motor vehicle manufacturers; as a tier two supplier, if it sells parts primarily to tier one suppliers; and as a tier three supplier, if it sells parts primarily to tier two suppliers. OEM suppliers were especially hard hit by recent changes in the process of manufacturing motor vehicles.

General Motors, Ford, and to a lesser extent Chrysler dominated U.S. motor vehicle production for most of the twentieth century, in large measure because they made most of their own parts. Making their own parts

gave them control over technology and styling, as well as benefits from economies of scale. The parts they did purchase from independent suppliers, such as tires, mirrors, and bumpers, were less central to the core vehicle technology (engine and transmission).

Vertical integration came to be regarded as a competitive disadvantage in recent years, because independent companies could make parts cheaper and better. By buying most of their parts from outside suppliers, Japanese companies and DaimlerChrysler achieved lower production costs than the U.S.–owned manufacturers, especially General Motors.

Lean Production: Producer-Supplier Cooperation

Early motor vehicle producers were primarily assemblers and distributors, dependent on other companies to manufacture the parts that went into their vehicles. Early suppliers were typically firms with established reputations for making high-quality parts in other industries. When possible, vehicle assemblers purchased parts from the existing stock of suppliers and had skilled mechanics modify the parts and bolt them together. More complex and specialized parts sometimes had to be made to order from precise specifications.

With the emergence of Ford, General Motors, and later Chrysler as dominant U.S. mass-producers, companies making parts rather than entire vehicles were relegated to secondary status in the production process. Each year, suppliers competed with each other for contracts from the handful of vehicle manufacturers to produce parts according to precise specifications. The company submitting the lowest bid received a contract to supply a particular part for one year. To keep suppliers on their toes, General Motors often bought the same part from several companies, and deliberately changed suppliers of particular parts from year to year. Manufacturers did not share with suppliers information about how parts fit together, or their intentions for retaining or changing individual parts in the future.

Relationships between car makers and parts suppliers began to change in the United States during the 1980s, with the conversion from mass production to lean production. Under the Japanese concept of *keiretsu* (cross-ownership), vehicle producers turned over more responsibility to suppliers and created close linkages with them. Producer-supplier relations in lean production differed from the mass production model in several key ways. First, lean vehicle producers signed long-term cooperative agreements with suppliers instead of awarding contracts annually on a compet-

itive basis to the lowest bidder. Once a supplier of a component for a particular model was identified, a lean producer stuck with the same supplier at least through the life of the model (four to ten years). By the 1990s Japanese car makers had been dealing with many of the same suppliers since the 1950s or 1960s. Rather than accepting bids from competing suppliers, a lean producer set a target price for a component and asked a trusted supplier to meet the target—although the target was often moved downward.

Second, under lean production suppliers were selected on the basis of ability to meet quality standards instead of the lowest cost. Suppliers had to practice *kaizen* (continuous improvement) to hit the ever more ambitious quality and price targets set by producers. Defect rates, productivity, inventory, accident rate, absenteeism: a supplier had to constantly improve a wide variety of performance standards to earn the trust of the vehicle producers.

Third, vehicle producers shared with suppliers product development information of a type that had once been considered confidential. This sharing was made feasible by electronic communications, computer-assisted design, and other technological advances. In return, suppliers were expected to expand their research capabilities, so that they could participate in the development of suitable components for new vehicles. Most suppliers constructed or expanded research and development facilities in southwestern Michigan to facilitate closer personal relationships with the car makers' key engineers and researchers. Ford and General Motors, for their part, spun off their parts-making divisions in large measure to reduce two issues of confidentiality: independent suppliers feared that their proprietary secrets would be turned over by Ford and GM to their in-house components divisions, and other car makers feared that by doing business with Delphi and Visteon, their proprietary secrets would be turned over to GM and Ford.

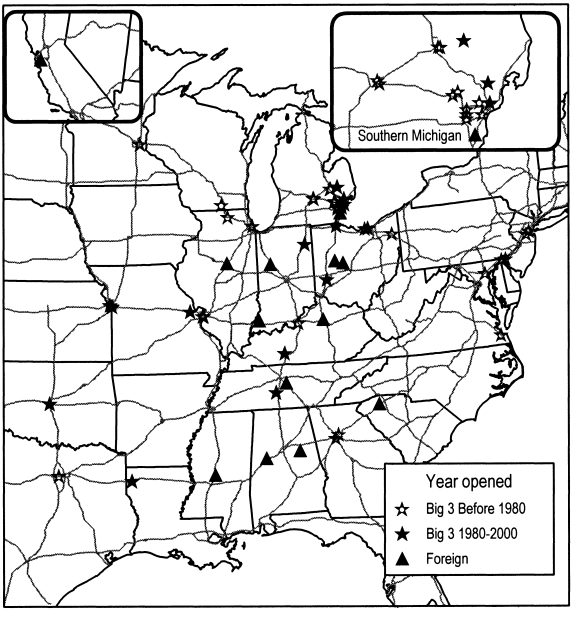
Fourth, car makers demanded delivery of components on a just-in-time basis. By receiving components shortly before needed on the final-assembly line, vehicle producers could reduce inventory and therefore costs, because they did not tie up as much money in inventory and could allocate less factory space to storage. For example, at the Johnson Controls seating plant in Lewisburg, Tennessee, a truck arrived every hour, sixty seats were loaded into the trailer, and the truck drove thirty miles to GM's Saturn final-assembly plant at Spring Hill. The seats were unloaded and delivered to the location on the final-assembly line where they were installed in the vehicles, exactly when needed and in the sequence needed. The complex lo-

gistics underlying just-in-time delivery were turned over to independent companies, such as Ryder. The final-assembly plant informed the logistics company of the factory production schedule, and the logistics company devised the routes and schedules and informed the suppliers of pickup times.[1]

Manufacturers located final-assembly plants in the interior of the United States during the 1980s and 1990s, largely to minimize the cost of shipping finished vehicles to dealers and customers around the country. As a fabricated product, a motor vehicle is much bulkier than the collection of the parts brought into the plant for assembly. A finished motor vehicle is also a delicate object that must be handled with care to avoid damage en route from the factory to the customer. As a result, the cost per mile of shipping out a finished vehicle is much higher than the aggregate cost of shipping in the parts to the final-assembly plant. Therefore, vehicle producers site final-assembly plants primarily to minimize the cost of shipping vehicles to the market.

Forty percent of the final-assembly plants in operation in the United States in 2000 were less than twenty years old, and nearly all were located in the interior of the country in order to minimize the aggregate cost of shipping throughout North America. All but a handful were situated within 50 miles of one of two main north-south interstate highways, I-65 and I-75 (Fig. 4.1). The north-south corridor between these two interstate highways became known as auto alley, or *kanban* highway, after the Japanese word for "just in time."

The clustering of assembly plants in the interior of the country in the 1980s and 1990s was a consequence of the proliferation in the number of models being produced. When the Big Three controlled 95 percent of the U.S. market during the 1950s, they assembled most of their vehicles at branch plants located around the country near population centers. For example, vehicles sold in the Southwest were assembled in the Los Angeles area. The number of different car and truck models sold in the United States increased from thirty in 1955 to several hundred in the 1990s. Assembly plants that had previously produced identical models for distribution within a regional market were converted into specialized plants producing a handful of models for national distribution. To minimize the cost of distributing products to a national market, automotive companies opened new plants in the interior and closed coastal ones. Suppliers similarly located facilities in the interior of the country, near the final-assembly plants. They employed two strategies in so doing. Some built factories near final-assembly plants to produce components, while others

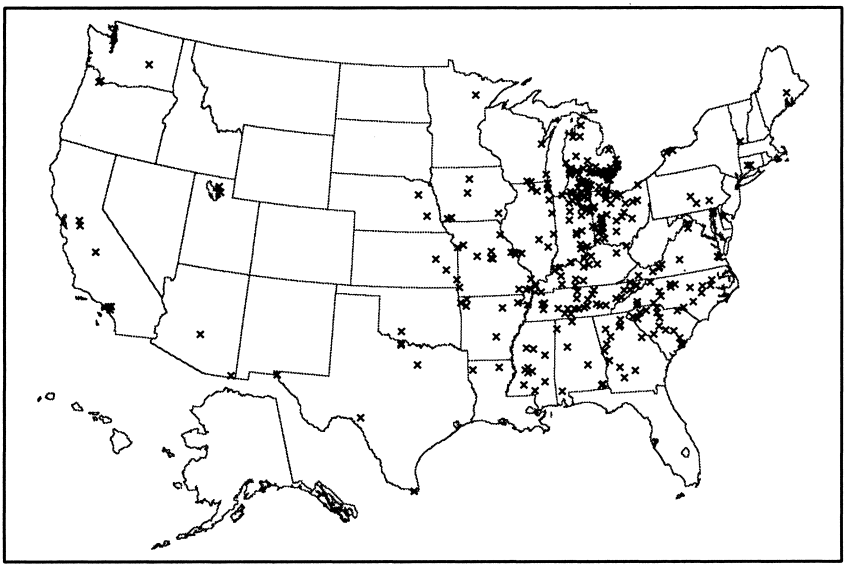


4.1. U.S. final-assembly plants, 2000.

produced components elsewhere and stored them in warehouses near final-assembly plants until needed.

In 2000 one-half of all supplier plants were located in the Midwest (one-fourth in Michigan and one-fourth in adjacent Great Lakes states, primarily Indiana and Ohio; Fig. 4.2). Another one-fourth were in the Southeast, especially Tennessee and Kentucky.[2] Before 1950 three-fourths of the supplier plants were located in the Midwest, compared to less than one-half during the 1970s and 1980s. Southeastern states had less than one-tenth of suppliers in operation before 1950, but more than one-third of plants opened between 1970 and 2000.

U.S.–owned suppliers had twice as many plants in the Midwest as in the Southeast in 2000, while foreign-owned suppliers split about evenly between midwestern and southeastern locations. Foreign-owned suppliers were especially attracted to the Southeast by low-wage, nonunionized labor and proximity to assembly plants. With increasing pressure to deliver the goods just in time, suppliers took another look at Michigan, Indiana, and Ohio during the 1990s. Southwestern Michigan, northeastern Indiana, and northwestern Ohio offered suppliers an attractive compromise: proximity to the corporate headquarters and research and development facili-



4.2. U.S. plants opened by 150 largest suppliers, 1970–2000.

ties clustered in the Detroit area, yet some distance from the high cost, high crime, and high congestion of the big city.

Optimum Lean Production: Fewer and Larger Suppliers

From the perspective of car makers, many of the features of lean production did not change dramatically under optimum lean production. Suppliers were still selected on the basis of quality rather than price, and were awarded long-term contracts. Producers still cooperated closely with suppliers, and just-in-time delivery was still expected. From the perspective of suppliers, however, optimum lean production caused a major upheaval. Because of optimum lean production, fewer, larger companies supplied car makers with fewer, larger parts.

The number of tier one suppliers selling parts directly to car makers decreased by more than one-half during the 1990s. Chrysler reduced its number of tier one suppliers most dramatically, from 3,000 in the 1980s to 1,200 in the early 1990s and to 900 at the time of the 1998 Daimler-Benz takeover. Chrysler obtained 80 percent of its components from about 100 tier one suppliers, and 90 percent of components from 150 suppliers. Ford cut its tier one parts suppliers from 2,040 in 1997 to 1,150 in 2000, when it received 80 percent of its parts from 200 suppliers. At GM, 80 percent of

parts were supplied by about 400 companies in the 1990s, down from about 700 suppliers in the 1980s.[3]

The desire of motor vehicle manufacturers to deal with fewer suppliers left parts makers with three choices: grow large enough to meet the needs of producers, be gobbled up by another supplier, or drop to tier two status as a producer of parts for other suppliers rather than directly for car makers. All three strategies were widely pursued during the 1990s.

The top 150 suppliers to North American vehicle manufacturers, ranked according to sales in the previous year, were identified annually in *Automotive News* beginning in 1995. Only 70 of the 150 largest suppliers on the 1995 *Automotive News* list remained as top suppliers six years later. The other 80 were dropped, for three different reasons: 36 were no longer among the 150 largest, 41 were sold, and 3 had been erroneously included in the original list.

The 36 top suppliers in 1995 that were no longer among the 150 largest in 2001 included 17 suppliers of engine components, 15 suppliers of body components, and 4 suppliers of chassis components. Average sales for the 36 suppliers dropped from the list had been $109 million in 1994, and the company ranked number 150 that year had sales of $34 million; in 2000 the supplier ranked number 150 had had sales of $216 million. Most of the deleted companies remained tier one suppliers, although some had dropped to tier two status.

Of most interest from the perspective of changes in the supplier industry was the 41 companies removed from the list because they had been sold in the last six years. They included 15 sold to companies already among the top 150 suppliers in 1995, and 26 sold to companies that grew into top 150 suppliers.

Surviving tier one suppliers became much bigger, as measured by annual North American OEM sales. The 70 firms appearing on both the 1995 and 2001 lists as ranking among the top 150 suppliers increased their combined sales from $79 billion in 1994 to $144 billion in 2000, an average annual increase of 12 percent. Of the 70 companies, 32 more than doubled their sales in six years, 31 grew by less than 100 percent, and 7 declined.

The large-scale shuffling of companies included in the list of top suppliers had international implications. Of the largest 150 suppliers, 79 were foreign-owned in 2001, compared to 43 in 1995. In those six years, 52 foreign-owned companies were added to the list of top suppliers, and 16 were dropped. Meanwhile, the number of U.S.–owned companies on the list dropped from 107 to 71, with the addition of 29 firms and deletion of 65.

Japanese and German firms accounted for most of the international investment. Japanese suppliers held 30 of the top 150 slots in 2001; German suppliers, 14; Canadian suppliers, 11; British suppliers, 7; French suppliers, 6; Mexican suppliers, 3; Italian suppliers, 2; and Dutch, Swedish, and Swiss suppliers, 1 each. In addition, 3 suppliers were joint ventures involving companies from 2 different countries. The 43 top foreign firms in 1995 included 13 Japanese, 9 German, 4 each British and Canadian, 3 each French and Mexican, 1 each Austrian, Belgian, and Brazilian, and 4 joint ventures.

Parts Supplied as Modules

Surviving tier one suppliers consolidated into fewer, larger companies so that they could provide manufacturers with large modules. The motor vehicle industry evolved a hierarchy of parts, components, systems, and modules. A *part* was typically a small, individual piece, either a standardized generic item, such as a bolt, or a piece of metal, rubber, or plastic stamped, cut, or molded into a distinctive shape. A *component* consisted of several parts put together into a recognizable feature, such as a seat cover or camshaft. A *system* combined several components to make a functional portion of a motor vehicle, such as an instrument panel or a transaxle. A *module* integrated several systems into one of a handful of major units of a motor vehicle, such as a passenger compartment or engine.

Traditionally, producers assembled vehicles from thousands of individual parts supplied by thousands of individual companies. For example, knobs, wires, stamped metals, and gauges were sent by different suppliers to the final-assembly plants for fashioning into instrument panels. Beginning in the 1980s, suppliers were asked to provide components instead of parts, then systems instead of components, and finally modules instead of systems.

Under lean production practices during the 1980s, U.S. vehicle producers contracted with suppliers to receive larger components. For example, one supplier could send radios complete with wires and knobs, ready to pop into the instrument panel. During the 1990s, instead of smaller parts and components, suppliers sent systems, such as entire instrument panels, complete with knobs, gauges, and padding.

Manufacturers using optimum lean production preferred to buy very large modules from a handful of suppliers. For example, one supplier could be contracted to provide not just instrument panels, but seats, doors,

headliners, floors—the entire passenger compartment. At the start of the twenty-first century vehicle producers were in transition, meeting some of their needs through buying large modules and systems, but still buying some small components and parts.

Under optimum lean production, sales of generic parts and components were increasingly conducted through Internet auctions. Tier one suppliers were especially active in purchasing routine parts through on-line exchanges for the complete systems and modules they were asked to provide to car makers. In an Internet auction, a buyer (typically a vehicle manufacturer or a tier one supplier) put out over the Internet specifications about a desired part, and a producer submitted a bid stating the price at which it could make the part. The purchaser could choose the lowest bidder.

The largest on-line trading company in 2001 was Covisint, established by DaimlerChrysler, Ford, GM (including Fiat), and Renault (including Nissan), with expected parts sales of $240 billion in its first year. The first on-line transaction on Covisint in October 2000 was tier one supplier ArvinMeritor's purchase of an injection-molded plastic part for its suspension and exhaust system. Other on-line parts exchanges began earlier in 2000, including FreeMarkets' B2B eMarketplace (with $11 billion in sales in 2000) and Electronic Supplier Link (sponsored by Volkswagen).

The thousands of parts that went into a motor vehicle basically contributed to two main functions: some of the parts helped to create the power by which the vehicle was propelled, and some helped to create the body that held the power source, as well as passengers and goods. The body consisted of two principal modules: the passenger compartment and the exterior skin. The powertrain consisted of three principal modules: chassis, engine, and drivetrain. The change from supplying parts and components to supplying systems and modules affected suppliers in each of the five areas differently.

Passenger Compartment

The interior is the portion of the vehicle that motorists experience most intensely: it is where they sit, what they see, and what makes them feel comfortable or uncomfortable. Producers therefore want a space designed to comfort and pamper the driver and passengers. As the interior adds relatively little value to the vehicle compared to its bulk, vehicle manufacturers have been especially eager to turn over much of the responsibility for vehicle interiors to independent suppliers.

Under lean production, interiors were produced as five main systems: seat, door, instrument panel, floor, and ceiling. Under optimum lean production, independent suppliers found that the economies of scale needed to make a profit on bulky, low-value components came from supplying an entire interior module rather than one or two of the five systems. As described earlier, vehicle producers historically purchased components to assemble their own seats, but in the 1980s they began to contract with suppliers to obtain seats ready to install in vehicles on the final-assembly line.

A passenger compartment supplied as a module by a single company increased the probability that the components would fit together snugly and therefore minimize noise, vibration, and harshness. A unified, harmonious interior could be produced by having materials painted or dyed at the same time, cut from the same batch, and shaped uniformly.[4] A single supplier could create an integrated driver's position surrounded by gauges and controls.

Competition to produce interior modules was especially intense among three firms that emerged as dominant providers of seats in recent years: Lear Corporation, with about one-half of the U.S. seat market; Johnson Controls, Inc. (JCI), with about one-third; and Magna International, Inc., with about one-sixth. Lear became the largest supplier of seats to General Motors, JCI to Ford, and Magna to DaimlerChrysler.

Lear Corporation, originally known as American Metal Products, was established in 1917 by Frederick Matthai in Detroit to make seat frames. The aerospace producer Lear Siegler, Inc. purchased American Metal in 1966 and renamed it the General Seating Division in 1975. The division's management purchased the automotive seating business from Lear Siegler in 1988 and called the new company Lear Seating Corporation. Lear's interior business grew from $1 billion in 1990 to more than $8 billion in 2000, primarily from acquiring the seating operations of Ford in 1993 and of General Motors in 1998.

JCI, originally known as Johnson Electric Service Company, was founded in 1885 in Milwaukee by Warren Johnson, a professor at the State Normal School in Whitewater, Wisconsin, to make electric thermostats that automatically controlled room temperature. The company got into the automotive seat-making business by acquiring Hoover Universal, Inc. in 1978, Ferro Manufacturing Corporation in 1985, and Chrysler's Acustar Division seat plants in 1994. Hoover Universal, founded as the Hoover Steel Ball Company in 1913 to make ball bearings, had been making seat parts, such as frames, foam, and springs, since the 1960s. Ferro, founded in 1915,

made seat tracks and recliners, as well as door latches and window regulators. JCI also acquired Globe-Union, Inc., the country's largest manufacturer of automotive batteries, in 1978.

Magna, Canada's largest supplier, was started by Frank Stronach, an Austrian émigré who opened a one-man tool-and-die shop in suburban Toronto, Ontario, in the late 1950s. In 1970 he merged with Magna Electronics, a small aerospace and automotive supplier. Magna's electronics division was closed in the early 1970s, so that the company could concentrate on interior and exterior body parts.

Exterior Skin

The exterior of the body consists of several large panels stamped from steel sheets or in a few cases shaped from plastic or aluminum. The panels are welded or bolted together, painted, and fitted with windows and accessories, such as bumpers, mirrors, and lights. Changes in how exteriors were supplied were less dramatic in 2000 than for interiors: exteriors were still sent to the final-assembly plant as systems or even small components rather than as large modules. Motor vehicle producers performed most of the exterior operations themselves, either at the final-assembly plant or at specialized stamping plants.

Body Panels. Most bodies in the early years of the automotive industry were made by independent companies from wood, the cheapest and easiest material to use and a legacy of the carriage industry. Aluminum was used to make bodies for expensive cars, such as Marmon and Pierce-Arrow, because it could be fashioned into graceful shapes and was less likely to dent than steel. When steel began to predominate during the 1920s, Ford and General Motors stamped panels and assembled bodies at a plant twinned to a nearby final-assembly plant. For example, GM built Chevrolet bodies at a plant in Hamilton, Ohio, and shipped them by rail 15 miles south to a final-assembly plant in Norwood. Cadillac bodies were trucked through the streets of Detroit from the Fleetwood (Fort St.) stamping plant to the Clark Avenue final-assembly plant. Near the end of the moving line at the final-assembly plant, the body was dropped onto the chassis. Transportation of finished bodies by train or truck to a final-assembly plant hardly promoted strong body integrity or tight fit and finish.

Rather than shipping finished bodies, vehicle manufacturers now weld together stamped body panels at the final-assembly plant. Car makers either purchase stamped panels from independent companies or make the

panels at their own stamping plants from steel sheets supplied by steelmakers.

The leading independent supplier of steel body panels in 2000 was the German firm ThyssenKrupp Automotive AG, the product of a 1998 merger between Thyssen and Krupp-Hoescht. Krupp was a venerable German steelmaker, founded in 1811, and controlled by five generations of the Krupp family until it became a public corporation in 1992. Thyssen became the major U.S. body manufacturer in 1978, when it acquired the Budd Company. Founded by Edward Budd in Philadelphia in 1912, Budd pioneered production of an all-steel body, first used on the 1914 Dodge.

Glass. Production of windshields and side and rear windows remained fragmented among several manufacturers in 2000. The four major manufacturers of automotive glass in 2000 were Guardian Automotive Products, Pilkington-Libbey-Owens-Ford, PPG Industries, Inc., and Visteon Automotive Systems. Pilkington, a British glassmaker since 1826, acquired in stages during the 1980s Libbey-Owens-Ford (LOF), itself the product of a 1930 merger between two U.S. glass firms, Libbey Owens and the Edward Ford Plate Glass Company. Guardian began in 1932 as a small fabricator of windshields for the automotive industry. Visteon inherited the Ford Motor Company's glass-making operations, established by Henry Ford at the Rouge plant and several other facilities around the country. PPG Industries was founded in 1883 as the Pittsburgh Plate Glass Company.

Paint and Coatings. Paint is applied in the final-assembly plant after the body panels have been welded together. The paint shop has become the most elaborate and costly part of the final-assembly plant. Car makers spend large sums—on the order of $500 million per assembly plant—to upgrade their paint shops, so that the paint stays affixed to the vehicles, and the waste paint and fluids are disposed of safely. In addition to supplying glass, PPG was also one of the major suppliers of paint and other finishes and coatings that are applied to the body panels, along with DuPont Automotive and BASF Corporation.

Color preferences changed many times over the past half-century. Two-toned paint jobs of white and pastels—turquoise, aqua, pink, coral, light gray, baby blue, and chartreuse—burst on the scene in the 1950s, with garish interiors color-keyed to the exterior. Even livelier colors—orange, lemon yellow, candy apple red, blue, lilac, and yellow-green—appeared during the social turbulence of the 1960s. Muted earth tones, such as

green—a symbol of harmony to reduce emotional stress—prevailed during the calmer 1970s. Blacks and grays yielded to reds and blues during the go-go 1980s. The quiet elegance of gold and copper were preferred during the prosperous 1990s, and dark, rich greens reflected increasing interest in preserving nature. Colors favored by clothing designers often appear on motor vehicle a few years later.[5]

Bumpers. Two Canadian companies dominated production of bumpers in 2000. A. G. Simpson Automotive, Inc. was the leading producer of steel bumpers, Magna's Decoma Exterior Systems the leading supplier of plastic bumpers.

Chassis

The chassis of a motor vehicle consists of a metal frame to which are attached components that enhance handling and comfort, including wheels, tires, brakes, and suspension. Production of each of the major chassis components has become concentrated in the hands of a few suppliers.

Frame. The chassis is built on a frame of two long, shaped bars connected by several shorter cross-pieces. Most vehicle frames until the 1920s were made of wood, which was lighter and stronger than steel, and produced a quieter ride. Wood frames, though, took much longer to make than pressed-steel ones, and when suppliers could not make wood frames fast enough to meet the speed of the moving assembly line, car makers turned to pressed-steel frames. The leading producer of frames in the United States for most of the twentieth century was A. O. Smith, which pioneered pressed-steel frame production in 1899.[6] Tower Automotive, Inc., a body-part stamper, acquired A. O. Smith in 1997.

Wheels. Early motor vehicles rode on enormous wood wheels—more than 4 feet in diameter—with wooden spokes radiating from a central hub in so-called "artillery" style. These were replaced by smaller, lightweight, wire-mesh wheels during the 1910s, then during the 1920s by pressed-steel disk wheels, painted the same color as the body; in the 1930s the wheels were covered by decorative pressed-steel hubcaps. Aluminum became the most popular wheel material during the 1990s. Although more expensive than steel, aluminum weighed less and eliminated the need for hubcaps, thereby helping fuel efficiency.[7]

The major wheel supplier in the United States in 2000, Hayes Lemmerz

International, Inc., traced its origin to two early suppliers of wooden wheels: Hayes Wheel Company, founded by John Hayes in 1908, and Kelsey Wheel Company (originally K. H. Wheel Company), founded by John Kelsey and John Herbert in 1909. When steel wheels replaced wooden ones, the two companies merged in 1927 to form Kelsey-Hayes Wheel Corporation. Varity (later LucasVarity) acquired Kelsey-Hayes in 1989, then three years later spun off an independent wheel business called Hayes Wheels Company. In 1997 Hayes bought 77 percent of Lemmerz Holding GmbH, a German wheel maker since the 1920s.

Tires. The life of an early automobile tire was short and nasty. Motorists in 1900 could expect their tires to last perhaps 100 miles. At $50 per tire, replacing tires was a major operating expense. A succession of innovations extended the life of a tire and protected it from damage. These included the cord tire and demountable rim in the 1910s; the low-pressure balloon tire in the 1920s; the tubeless, bias-belted tire in the 1940s; the fiberglass, bias-ply tire in the 1960s; and the radial tire in the 1970s.

As the tire became a low-cost, high-quality, long-lasting commodity, with little differentiation among competitors, tire suppliers were especially ripe for global consolidation during the late twentieth century. In 2000 four firms—Goodyear Tire & Rubber Company, Michelin North America, Inc., Bridgestone/ Firestone, Inc., and Continental NA—supplied nearly all North American original equipment tires.[8] Reflecting the globalization of the tire industry, Goodyear had its headquarters in the United States; Michelin, in France; Bridgestone, in Japan; and Continental, in Germany.

Goodyear was the last survivor of several American rubber companies that clustered in Akron, Ohio, in the late nineteenth century, at the birth of the automotive industry. It became the world's largest tire producer in 1999 after acquiring control of Japan's second-largest and the world's fifth-largest tire maker, Sumitomo Rubber Industries, which in turn had acquired the British tire maker, Dunlop Company, in 1986.

Michelin was founded in 1889 in Clermont-Ferrand, France, when Édouard Michelin, the company's first manager, and his brother André took over the agricultural equipment business founded by their grandfather, Aristide Barbier, and his cousin. The company in 1891 patented a removable tire originally for bicycles and adapted to early motor vehicles. Its major early automotive contribution was the pneumatic tire in 1895. The company's best-known advertising symbol, the Michelin Man, was created in 1898 to promote pneumatic tires. Michelin became one of the

largest tire suppliers in the United States in 1990 after acquiring Uniroyal Goodrich, which in turn was the product of a 1986 merger between two large, Akron-based companies, United States Rubber Company and B. F. Goodrich Company.

The Bridgestone Tire Company was Japan's first tire company, founded in 1931 by Shojiro Ishibashi, who had been producing traditional, rubber-soled footwear known as *tabi* since 1923. Ishibashi called the company Bridgestone because his own surname meant "stone bridge" in Japanese, and he transposed the syllables to produce a corporate name similar to one of the largest American tire makers: the Firestone Tire and Rubber Company, which he admired and eventually acquired in 1988.

Firestone's ability to survive as a major U.S. tire maker in the twenty-first century appeared highly doubtful in 2000, following documentation that at least 148 fatalities had resulted from separation of treads on its tires. Most of the problems occurred with Firestone tires on Ford's popular Explorer sport utility vehicle. A recall was issued in 2001 for 13 million Firestone tires. Sales plummeted when manufacturers equipped new vehicles with tires made by other companies, and owners of older vehicles removed their Firestone tires. Firestone blamed the problem on specific manufacturing problems at its Decatur, Illinois, plant, and Ford's recommendation that tire pressure be kept low. Ironically, much of the success enjoyed by the Ford and Firestone companies early in the twentieth century was based on the extremely close friendship between their founders, Henry Ford and Harry Firestone.

Continental's early history in Germany was similar to that of Michelin in France. The first German company to manufacture pneumatic tires, for bicycles in 1892, then for motor vehicles in 1898, Continental captured a major portion of the U.S. market in 1986 by acquiring General Tire, Inc., then the third-largest U.S. tire maker.

Brakes. Until the 1920s motor vehicles had brakes attached only to the rear wheels. Braking all four wheels was considered dangerous, for fear that the wheels could lock up and the car might roll over.[9] Most common was the drum brake—a shoe made of a friction material that pressed tightly against a drum when the brake pedal was depressed, to keep the wheel from turning.

Disc brakes, which replaced drums on most cars during the 1960s, stopped the vehicle by pressing flat, disc-shaped rotors made of a friction material against both the inside and outside of the wheels. Nearly all ve-

hicles sold in North America in 2000 were equipped with an antilock brake system (ABS), in which computers controlled the amount of pressure on the wheels exerted by each disc. When the price of ABS quickly dropped during the 1990s, most brake suppliers ceased production. By 2000, there remained just four: Continental, Delphi, Robert Bosch Corporation, and TRW, Inc.

In the early 1990s, while still a GM division, Delphi was the first producer of a low-cost ABS, and GM was the first car maker to install ABS as standard equipment even in its lower priced models. Continental expanded from tires into brakes by acquiring ITT Industries' Automotive Brake and Chassis Division in 1998. Robert Bosch first made ABS for European luxury cars in 1978, but remained a minor player in the North American brake market until it acquired AlliedSignal's Bendix Division in 1996. TRW, Inc. became a major brake manufacturer after it acquired LucasVarity PLC in 1999. LucasVarity had been created only three years earlier, through a merger of Lucas Industries PLC and Varity Corporation. Lucas had been a major supplier of disc brakes in Europe, while Varity had specialized in low-cost, two-wheel ABS for trucks in North America. Varity became a brake supplier in 1989, when it purchased K-H Corporation, previously known as Kelsey-Hayes, which had made brakes since 1928.[10]

Suspension. When a car hits a bump, the suspension system makes certain that the wheels maintain maximum contact with the road. The suspension system also includes shock absorbers attached to the wheels, to provide passengers with a smooth ride.

The leading producers of suspension components in 2000 included Tenneco Automotive, Inc. and ThyssenKrupp. Tenneco entered the industry through its acquisition of Walker Manufacturing in 1967 and Monroe Auto Equipment in 1977. Walker, founded in 1888 in Racine, Wisconsin, made springs for horse-drawn wagons. Monroe, founded in 1916 as the Brisk Blast Manufacturing Company, invented the first shock absorber in 1926. Krupp became a major supplier of suspension components through acquisition of Hoescht, which made coil and leaf springs, torsion and stabilizer bars, shock absorbers, and spring struts, as well as such drivetrain and engine components as crankshafts, connecting rods, and piston heads.

Roll-in Chassis. Under the influence of lean production, suppliers of individual chassis components provided a "four corner" chassis system during the 1990s, so named because it integrated the wheel, tire, brake, and

suspension components at the four corners of the vehicle. Under optimum lean production, suppliers progressed one step further to offer a chassis module, known as a roll-in chassis, which integrated drivetrain components with the chassis system. The module was called a roll-in chassis because it was literally pushed into an assembly plant on its tires. Dana Corporation (discussed below as a major drivetrain supplier) was the leading producer of the roll-in chassis.[11]

Drivetrain

The drivetrain harnesses the engine's power to propel the vehicle forward or backward at a desired speed. Major drivetrain systems include the transmission, which houses several gears for changing the vehicle's speed; the axle, which relays power laterally to the wheels; and the steering, which propels the vehicle in the desired direction. The gears in the transmission change the rotation speed, or torque, that the engine's crankshaft produces. At moderate speeds, as in typical city driving, the crankshaft turns much more rapidly than is needed to propel the vehicle, so gears are engaged that slow the torque. On the other hand, starting a stationary vehicle or ascending a steep grade may require some boosting of engine torque.

Transmissions. Gears are changed either manually or automatically. In Europe and less developed countries, most vehicles have manual transmissions, in which gears are shifted by simultaneously moving the gearshift and depressing the clutch pedal. Engaging the clutch uncouples the engine from the transmission, allowing the gear to be changed without damaging the gear teeth. Early transmissions were difficult to shift into various positions without clashing the gears or even stripping them altogether, but improving the clutch and using gears of stronger steel construction reduced the problem.

Nearly all vehicles sold in North America and Japan have automatic transmissions, in which gear ratios are shifted automatically without interrupting engine torque. General Motors offered the first fully automatic transmission on Oldsmobiles in 1940 as a $100 option. Automatic transmissions became a common option on low-priced cars in the United States during the 1950s, with manual transmissions confined to a handful of small or sporty models.

Motor vehicle producers manufacture most of the transmissions placed in their cars, but independent suppliers provide transmissions for some trucks. The leading independent supplier of automatic transmissions in

2000 was BorgWarner Automotive, Inc. The company was formed in 1928 through the merger of Borg & Beck, which made clutches, Warner Gear, which made transmissions, Marvel Carburetor, and Mechanics Universal Joint.

ZF Group, a German company that made manual transmissions for Ford trucks, took over a Ford transmission plant in Batavia, Ohio, in 1999, in order to manufacture continuously variable transmissions (CVT). Instead of using hydraulic clutches, CVT delivers torque from the engine to the wheels by means of a flexible steel belt positioned between two pairs of pulleys. As the vehicle increases in speed, one pair of pulleys moves closer together, while the other moves farther apart. The gear ratio changes as the belt moves toward the center of the separating pair of pulleys and toward the circumference of the pair moving closer together.

Driveshaft and Axles. Power may be sent from the transmission to the rear axle, the front axle, or both axles. On a rear-wheel drive or an all-wheel-drive vehicle, the transmission sends power along a driveshaft to the differential, which relays the rotating driveshaft laterally through an axle to the wheels. On a front-wheel-drive vehicle, the transmission and differential are combined into one assembly, known as a transaxle. The differential allows the two wheels to turn at different speeds, which is necessary because when a vehicle turns, the inner wheel follows a smaller arc than the outer one. Vehicle producers purchase axles, driveshafts, and differentials from a handful of large independent suppliers.

The major driveshaft manufacturer through the twentieth century was Dana Corporation, originally known as the Spicer Universal Joint Manufacturing Company, founded in 1904. The company's founder Charles W. Spicer patented a tubular shaft with flexible joints, called a U-joint, that was quieter and more reliable than early chain-and-sprocket transmissions, which frequently broke or slipped off the sprockets and permitted only a narrow range of axle movement. The company was renamed Dana Corporation in 1946 in honor of Charles Dana, who had reorganized the company in 1914.[12]

Dana was also one of the two major suppliers of axles for automobiles, along with American Axle & Manufacturing, Inc. (AAM). AAM was established in 1994 when General Motors sold several of its Saginaw Division plants in the Buffalo and Detroit areas. AAM made front and rear axles, as well as differentials, shafts, steering linkages, and steering and suspension parts; in 2000 more than 95 percent of its production was sold to GM.

Eaton Corporation and ArvinMeritor, Inc. were major manufacturers of heavy-duty truck axles. J. O. Eaton, founder of the Eaton Axle Company in 1919, had been one of the founders of Torbensen Gear and Axle Company eight years earlier, along with V. V. Torbensen and Henning O. Taube. After Torbensen Gear and Axle was sold to Republic Motor Truck Company in 1917, Eaton left to start his own company, then repurchased Torbensen from Republic in 1922. ArvinMeritor was created in 2000 through a merger of Arvin Industries, Inc. and Meritor Automotive, Inc. Meritor itself was a 1997 spinoff from Rockwell International Corporation. The Rockwell Spring & Axle Company was established in 1953 by Willard Rockwell through a merger of Timken Detroit Axle Company, Wisconsin Parts Company, and Standard Steel & Spring. Arvin was a leading producer of shocks and exhaust systems.

Cashing in on the boom in sport utility vehicles, Chrysler and General Motors formed New Venture Gear, Inc. in 1990 to produce transfer cases, which send power to the second set of wheels in four-wheel-drive vehicles. New Venture had two-thirds of the U.S. market for transfer cases in 2000 and also produced manual transmissions for trucks. BorgWarner was also a major producer of manual transmissions and transfer cases in the United States.

Steering System. The steering system enables the driver to guide the car's direction. The rotating movement of the steering column activates a series of gears, shafts, and rods that turn the wheels. TRW was the largest independent supplier of gears, linkages, and other steering components, the product of a 1958 merger between Thompson Products, Inc. and defense electronics company Ramo-Woodridge Corporation. Thompson was founded in 1901 as the Cleveland Cap Screw Company, to make engine valves for Winton cars, assembled in Cleveland. Several years later Winton bought Cleveland Cap Screw, changed the name to Electric Welding Company in 1908, and in 1915 sold it to Charles Thompson, who changed the name to Steel Products Company, then to Thompson Products, Inc. in 1926.

Engine

The engine is the most costly and elaborate part of a vehicle. Its heart is several cylinders—normally four, six, or eight—inside which pistons move up and down in four cycles or strokes. In the first, or intake, stroke, the piston moves down as an intake valve opens in the cylinder, and fuel is in-

jected into the cylinder. In the second, or compression, stroke, the piston moves up, compressing the fuel. In the third, or power, stroke, the fuel is ignited by a spark, expands, and pushes down the piston. In the fourth, or exhaust, stroke, the burned fuel is removed through an exhaust valve in the cylinder, allowing the piston to move up. The burned fuel is vented through an exhaust system, which also quiets the engine.

The pistons are connected to a crankshaft, which converts the reciprocal up-and-down motions of the pistons into a twisting, or rotary, force called torque. The crankshaft is connected to a camshaft that opens and closes the cylinder valves during the four strokes. The crankshaft also turns various belts and pulleys connected to pumps and fans that cool and lubricate the engine.

Engine Suppliers. Given the central importance of the engine to a motor vehicle's functioning, as well as its character, car makers historically produced nearly all of their own engines. However, independent engine manufacturers carved out a lucrative niche in the late twentieth century by supplying diesel-powered engines for the growing truck market. The leading independent supplier of diesel engines was Cummins Engine Company, which began during the 1980s to sell struggling Chrysler diesel engines for its pickup trucks. At that time, Chrysler had less than 10 percent of the U.S. pickup truck market and lacked the resources to build its own diesels, as Ford and GM did.[13]

Detroit Diesel Corporation and Navistar International Engine Group also became major suppliers of diesel engines. Navistar originated in the nineteenth century as a manufacturer of farm equipment, including Cyrus McCormick's reaper, and took the name International Harvester around 1900. The company's truck and engine operations were renamed Navistar in 1986, when other divisions, including agriculture and construction, were sold. Detroit Diesel Corporation began in 1938 as the Detroit Diesel Engine Division of General Motors, and merged with GM's Allison Division to form the Detroit Diesel Allison Division in 1970. GM created Detroit Diesel Corporation in 1988 as a joint venture with Penske Corporation, and converted it to an independent company in 1993.

Although motor vehicle manufacturers historically built their own engines, they did buy from independent suppliers many of the engine components, such as pistons, valves, cylinder sleeves, and camshafts, as well as systems closely related to engine performance, such as fuel and exhaust. Federal-Mogul Corporation was the largest supplier of engine components

in 2000, including pistons, bushings, piston pins and rings, washers, cylinder liners, connecting rods, and bearings. TRW produced valves and valve train components. Freudenberg & NOK Group Companies, a joint venture between the German company Freudenberg & Company and the Japanese firm NOK Group, made engine sealing systems. Federal-Mogul and Freudenberg-NOK aspired to produce as many engine components as possible, to become one-stop shopping centers for car makers and independent manufacturers of engines.

Fuel and Exhaust Lines. The fuel line includes a tank to store gasoline, rails to carry the gasoline from the tank to the engine, and pumps and sensors to control the flow of fuel to the engine. The leading supplier of such fluid-handling systems in 2000 was TI Group Automotive Systems, a British company that acquired Bundy Group and Walbro Corporation during the 1990s.

The exhaust system removes burned fuel from the engine cylinders and expels it through a tailpipe at the rear of the vehicle. Pipes underneath the vehicle carry the fumes from the engine to the tailpipe so that passengers do not inhale them. Attached to the tailpipe is a muffler, which reduces the noise of the engine expelling the burned fuel. Also attached, beginning with 1975 models, is a catalytic converter, which reduces hydrocarbon and carbon monoxide emissions from the exhaust.

Most exhaust systems were sold as replacement equipment by large chains such as Midas. Suppliers of exhaust systems have large aftermarket sales, because the exhaust pipes and muffler corrode easily, especially in northern areas where liberal doses of salt are spread on the roads during the winter to clear snow and ice. The dominant producers of original equipment exhaust systems in 2000 were ArvinMeritor and Tenneco.

Heating and Cooling. An engine produces a large amount of waste heat, so it must be cooled to avoid self-destruction. If the temperature of the engine cylinder wall exceeds a certain level, the engine's coolant will boil, resulting in the engine overheating. A water pump circulates water in a water jacket around the engine block to keep it cool. The coolant flows past a thermostat and into a radiator, where it is cooled by air passing through the fins. The French company Valeo, Inc. was the leading supplier of engine cooling systems in 2000, as well as a major supplier of lighting, clutches, and other transmission components.

Motor vehicles contain so-called HVAC systems (heating, ventilating,

and air conditioning) that regulate the temperature of the passenger compartment as well as the engine. Air conditioning first became available as original equipment during the 1950s. As recently as 1980 half of the vehicles in the United States did not have air conditioning, but by 1994 only 1 percent of cars and 13 percent of trucks lacked air conditioning, primarily small pickups and sport utility vehicles. A car without air conditioning must be special-ordered from the assembly plant.

The leading manufacturers of air conditioners in 2000 were Delphi Automotive's Harrison Thermal Systems and Visteon Climate Control Division, each with about 40 percent of the market. The leading independent supplier of heating and air conditioning systems was the Japanese company Denso Corporation, founded in 1949.

Electrical and Electronic Components. Electrical components were attached to the engine beginning with Kettering's automatic starter in 1912, which eliminated the need to manually turn the flywheel, and Bosch's integrated system of magneto, spark plugs, starter, generator, headlights, and regulator cutout in 1913. Other electrical components followed: an electric Klaxon soon replaced a bulb horn, and electric headlights replaced acetylene lights. The Galvin Manufacturing Corporation, founded by Paul Galvin, introduced in 1930 the first low-cost, mass-produced car radio, which it called Motorola, later the name adopted for the entire company.

A 6-volt, lead-acid battery, which replaced the magneto in the 1920s, provided a more reliable source of power for starting the ignition and permitted use of accessories when the engine was not running. Once the engine was running, a generator or alternator driven by a belt attached to the engine crankshaft could operate electrical accessories and store the excess output in the battery. A 14-volt battery accommodated larger engines with faster cranking torque on 1950s American cars and also more elaborate electrical accessories, such as motors to operate power doors, seats, and windows. The Volkswagen Beetle retained a 6-volt battery until 1967.

Manufacturers replaced electrical systems with electronics beginning with the ignition system in the 1970s. Microprocessors soon controlled most aspects of the performance of the engine, transmission, chassis, and interior systems through electronic sensors, motors, instruments, terminals, and switches. Drivers learned that when the "check engine" light lit up on the instrument panel, the vehicle had to be taken to a trained mechanic who plugged in a diagnostic machine to identify the problem. With demand for electrical energy rapidly increasing, manufacturers in the early

twenty-first century moved toward replacing the 14-volt battery with one of 42 volts.

In view of the sudden prominence of electronics, responsibility for providing electronic components by 2000 seemed less settled than responsibility for any other portion of the motor vehicle. Stakes were high for suppliers of electronics components, and as a result, every major supplier of a large system or complete module felt compelled to gain capability in electronics.

Two kinds of suppliers of electronic components grew rapidly during the 1990s. Some started as electrical specialists supporting the powertrain and interior modules produced by the car makers and other suppliers. Others started as suppliers of powertrain or body components and added electronic components to be able to produce integrated systems or modules.

Among the largest suppliers in 2000, Yazaki North America, Inc. was the leading electrical specialist, a producer of wire harnesses, the long bundles of wires that distribute power to accessories. Yazaki started in Japan in 1929, entered the North American market in 1966, and broadened its capability to produce entire electrical distribution systems during the 1990s, in part through acquisition of Chrysler's Acustar Wiring Division in 1994. Alcoa Fujikura Ltd. was created in 1984 as a joint venture between the U.S. firm Aluminum Company of America (Alcoa) and the Japanese company Fujikura Ltd. Siemens Automotive Corporation, created when the German firm Siemens AG acquired AlliedSignal's Bendix Electronics Group in 1988, made sensors for safety restraint systems and electronic controls for engine cooling, fuel injection, and interface of engine with transmission.

Nearly all large suppliers added electronics capabilities to their core competences during the 1990s. Among the three large suppliers of interior modules, Lear Corporation produced electronic controls to adjust seats and foot pedals; Magna International's Atoma group made keyless entry systems and low-current switching systems; and Johnson Controls made global positioning systems and digital compasses.

Among the largest powertrain suppliers, TRW offered electronic engine controls, including fuel injection, spark advance, and starting and ignition systems, as well as driver convenience and assistance systems, such as remote keyless entry, seat and heat controls, information displays, power steering, and climate controls. Eaton Corporation produced electronic components to complement its powertrain systems, including solenoids to control fluids, gears, and torque converter; sensors to monitor ignition,

engine knock, and warning displays; and vacuum motors to open heating and cooling doors. Robert Bosch produced semiconductors, electronic control units, and sensors for engine management, engine cooling, and vehicle safety and stability. In addition to HVAC systems, Denso produced electronic starter, ignition, and fuel injection systems; controls for suspension, traction, and antilock brakes; power steering; and oxygen, vacuum, and coolant temperature sensors.

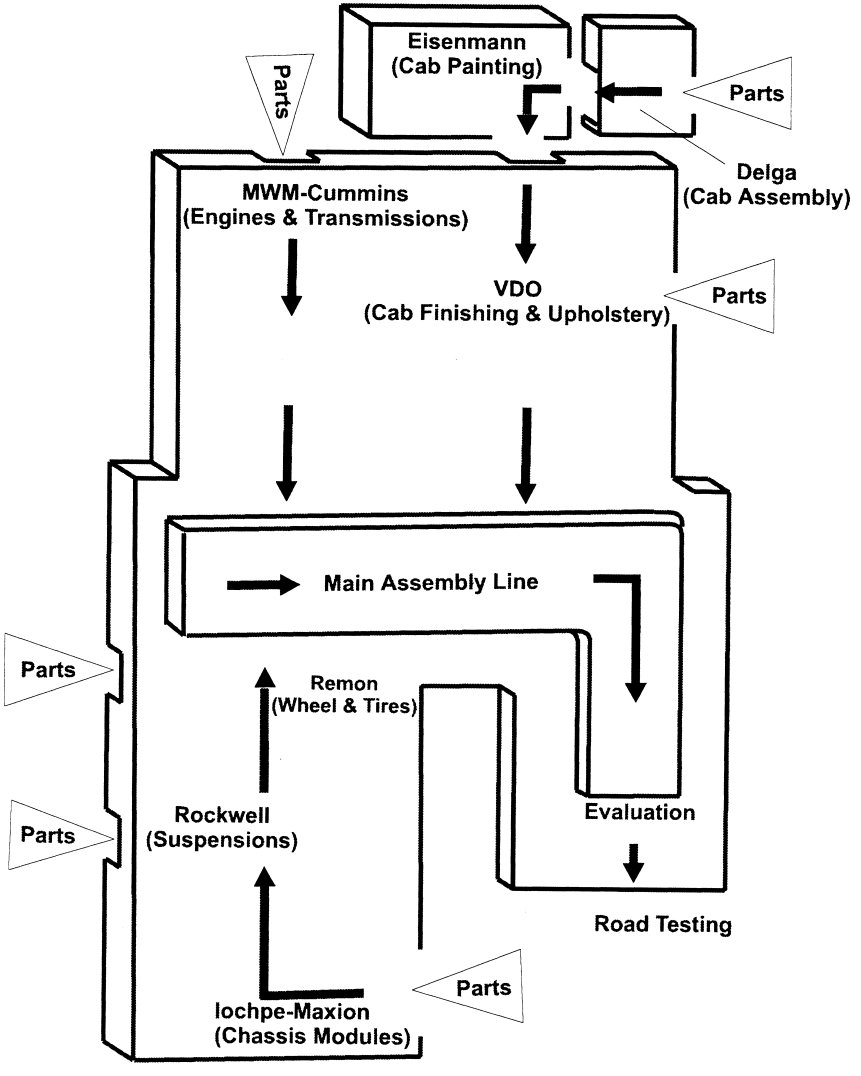
With electronics fundamental to the motor vehicle in 2000, the future of engine and engine component manufacturing was uncertain. If electronics controlled engine performance, would the architecture of the engine become dominated by manufacturers of the microprocessors rather than manufacturers of the mechanical components? Would Bosch, Denso, and Eaton be replaced by Hewlett-Packard, IBM, and Microsoft as major players in engine production? And would any of the companies providing engine electronics in 2000 adapt to the challenges posed to the gasoline-powered internal combustion engine by electric power and other alternative fuels (see chapter 8)?

The Modular Assembly Plant

For motor vehicle producers, the logical extension of purchasing large modules was to redesign final-assembly plants to turn over more responsibility to suppliers. Why operate a large final-assembly plant employing thousands of workers, when a handful of suppliers could deliver large modules ready for installation?

The first important example of a final-assembly plant operating under these optimum lean production principles was opened by Volkswagen in 1996 in Resende, Brazil, 100 miles northwest of Rio de Janeiro (Fig. 4.3). The plant's creator, José Ignacio López de Arriortúa, then VW's head of purchasing, claimed that the Resende plant represented the start of the third industrial revolution, after the steam engine and the moving assembly line. A charismatic figure in an industry populated by executives who, it has been said, couldn't motivate a cow to cross a road, López called the Resende plant a "fractal," using a term drawn from mathematics.

All assembly work at the Resende plant would be done by a handful of suppliers rather than by Volkswagen. Each supplier built and equipped its own work area, delineated by yellow lines painted on the floor, and suppliers contributed one-third of the $250 million plant construction cost. The VW employees in the plant, about 200—one-tenth the number at a



4.3. Volkswagen final-assembly plant, Resende, Brazil. The plant was one of the first examples of modular assembly, in which Volkswagen employees assembled modules supplied by a handful of suppliers. (Adapted from Schemo, "Is VW's New Plant Lean, or Just Mean?" and Sedgwick, "VW, Suppliers Work Side by Side")

typical assembly plant—had responsibility only for quality control, distribution, and research. The plant's other 800 workers were paid by the individual suppliers, although all were issued the same uniform to wear. Turning over production to suppliers allowed VW to focus on vehicle design and sales—its most lucrative operations.

Before going to Volkswagen, López had been director of purchasing for General Motors. He gained a reputation at GM as a hard-nosed negotiator with suppliers, demanding drastic cuts in prices, threatening to take away business if quality and price targets were not met. Defenders said his tactics were needed to shake up GM, which had the industry's highest purchasing costs. Critics charged that he disrupted operations with little benefit and peddled the proprietary work of one supplier to others to secure lower prices.

To keep López at GM, then president Jack Smith decided to promote him to president of North American Automotive Operations. López failed to appear at the 1993 press conference in Detroit when the public announcement of the promotion was to be made. The next day he turned up in Germany, having been appointed VW's director of purchasing. López said that he switched companies because GM was unwilling to build his dream plant, whereas VW promised to let him build it in his native Basque region of Spain. VW's financial problems and overcapacity in the European market shelved the Basque plant, but López was allowed to build one in Brazil instead.

General Motors had the same idea for building a low-cost plant in Brazil; located in Gravatai and called the Blue Macaw, the plant opened in 1999. Beaten to the punch by VW's 1996 plant opening, GM sued VW and López, claiming that López had stolen the plant ideas, along with thousands of other secret documents, when he jumped to VW, and that the plans were the product of a corporate process rather than one man's brainchild. GM and VW settled in January 1997, with VW agreeing to pay GM $100 million and to purchase at least $1 billion of parts from Delphi over seven years. López was forced to resign from VW in 1996. Soon after, he was critically injured in a car crash, remained in a coma for ten days, and was hospitalized for six weeks. In view of difficulties in prosecuting the case, as well as López's serious injuries, German prosecutors in 1998 agreed to drop the case against López in return for a contribution of 400,000 marks to charity.

Unable to convince a major car maker to build an innovative assembly plant in the Basque region, López in 1999 announced his plans to build his own cars, to be called Loar, from the first two letters of his two last names

(López de Arriortua). (*Loar* is also the Spanish word for "to laud.") He also sought to build Loar cars in Brazil, in a plant that not only would be operated primarily by suppliers according to modular assembly principles, but also would be owned by suppliers.[14]

Volkswagen's Resende plant, which had a capacity of 100 pickup trucks a day, was organized around three subassembly lines: chassis, powertrain, and body (see Fig. 4.3). The process began with a chassis delivered to a loading dock. Workers employed by Iochpe-Maxion, the largest Brazilian-owned supplier, placed components such as gas tank, transmission line, and steering box on the chassis. The chassis then moved to a station operated by a subsidiary of ArvinMeritor, where ArvinMeritor employees added axles and brakes. At the chassis' third stop, Remon attached wheels and tires.

The built-up chassis moved onto the main assembly line, where a subsidiary of Cummins Engine added the engine and transmission. Meanwhile, at another end of the plant, bodies were manufactured by the Brazilian company Delga Automotiva Industria e Comercio. Each body passed through a paint shop operated by the German company Motorenwerk of Mannheim Eisenmann, then to a station operated by VDO do Brasil, a subsidiary of Adolf Schindling AG of Germany, where seats and other interior components were added. The body went to the main assembly line, where it was dropped on the chassis.

Completed vehicles moved from the assembly line to an evaluation area run by Volkswagen. Critics worried that VW had turned over too much control to suppliers, and that a poorly performing supplier could not easily be replaced. But Volkswagen claimed to deal effectively with quality control issues by paying suppliers only when completed trucks passed final inspection.

The Resende plant promised to be the most efficient in the world, needing only eight hours to assemble a vehicle. Parts would be kept in inventory for only one or two days if worth more than $10; for one week, if worth $5 to $10; and for three weeks, if worth less than $5. However, critics charged that the cost savings resulted less from innovative organization than from low wages and harsh working conditions. For example, if the line had to be shut down to correct a defect, employees were not paid for the downtime, and they had to work overtime to earn their full pay, about $374 per month. VW countered that it guaranteed a production schedule nine weeks in advance and offered most workers training at a nearby technical institute.[15]

GM was the first to bring modular assembly to North America. To reduce by 20 percent the costs of assembling its small cars, GM proposed building assembly plants that snapped together a handful of modules made by suppliers. GM expected 20 percent of the savings to come from lower labor costs and 80 percent from the modular assembly and cheaper materials. The United Auto Workers union did not like the idea one bit, arguing that the real purpose was to transfer production from unionized GM workers to nonunionized suppliers. GM "officially" shelved the concept, which it had called Project Yellowstone, but to hedge its bet built or remodeled several plants capable of modular assembly.[16]

The restructuring of producer-supplier relationships to place more responsibility in the hands of a few, very large suppliers will continue in the twenty-first century. By 2000 restructuring was relatively advanced among suppliers of passenger compartments and chassis, less advanced among suppliers of exteriors and powertrains. Meanwhile, surviving tier one suppliers began to place the same pressures on tier two suppliers that they themselves had faced a few years earlier. Tier one suppliers began cutting in half the number of tier two suppliers. Surviving tier two suppliers were being asked to become more involved in the tier one suppliers' design and engineering work and to collaborate with other tier two suppliers during the design phase.

5 *From Deskilling the Work Force . . .*

The average worker . . . wants a job in which he does not have to think.
—Henry Ford

A LINE of expensive Potter & Johnson machines stood idle at the Ford Motor Company's Piquette Street assembly plant on Easter Monday, 1908, because no skilled mechanics were on duty to operate them. Also unstaffed were half of the plant's line of lathes on which camshafts were turned. Manpower shortages on these two lines were slowing the entire plant's production. Production chief Charles Sorensen discussed the problem with Henry Ford:

> Sorensen: "We are in real trouble, Mr. Ford."
> Ford: "Well, that is an easy thing to fix."
> Sorensen: "Easy to fix! Just how would you fix it?"
> Ford: "Why, go ahead and *make* some skilled men for the jobs. Go to the gate and take in unskilled men and train them."[1]

The Ford Motor Company had only nine employees when it was founded in 1903. Six of the nine made and fitted the parts—pattern maker Dick Kettlewell, draftsman August Degener, blacksmith Fred W. Seeman, and three skilled mechanics (Walter Gould, Harry Love, and John Wandersee). James Couzens was office manager, in charge of business affairs, bookkeeping, billing, collections, correspondence, and sales. C. Harold Wills, a mechanical engineer and draftsman, was the principal shop assistant, who carried out most of the detailed engineering work, such as preparing blueprints; among his many contributions, Wills designed the distinctive script logo that the company has always used. Henry Ford himself was vice president in charge of engineering and production.[2]

In 1903 all nine of Ford's employees were skilled craftsmen. By 1910 only one-third of the Ford workers were skilled, and by 1917, one-fifth. According to a Ford employee, speaking in 1926, "Workmen who have been

in the Ford plant, seeking jobs in another plant, when asked what their work was, will for example say, 'My work was to put on bolt No. 46.' Often it would take only 15 or 20 minutes to learn how to perform his little job efficiently."[3]

Fordist production required the attraction and retention of a large supply of laborers who were minimally skilled and remained so, yet who were capable of being fashioned into highly productive workers. Automotive manufacturing was a skilled operation in 1900, and workers controlled the handicraft-based production technology. Technological innovations, such as the moving assembly line, along with scientific management techniques that reorganized and fragmented production tasks into easily learned, performed, and supervised units enabled firms to impose much more rigid control over the work process.

The deskilling of the auto industry shattered the early balance of control of the workplace between workers and owners. Responsibility was removed from the skilled hands of craft workers, and a system of simplified, management-controlled mechanical operations was put into place instead. The unilateral, arbitrary imposition of poor working conditions by owners inevitably aroused workers' anger, culminating at mid-century in a bargain that stabilized a rough balance of power between the two warring sides. In exchange for working hard in routinized jobs, employees were rewarded with high levels of material comfort and security, protected by a strong union.

A century after it swept away the craft system, Fordist production was dismantled, replaced by flexible or lean production. As in the early twentieth century, in more recent years change in the organization of the workplace—introduced by management—provoked angry responses from workers. Employees saw that management was breaking the old deal, while the managers maintained that the survival of the firm was at risk. It took several decades for labor and management to work out a deal for peaceful coexistence under Fordist production, and it may take as long to sort out relationships under flexible production.

Working Conditions in the Early Years of the Auto Industry

Early craft production used a work force that was highly skilled in design, machine operations, and fittings. Most workers progressed through an apprenticeship to a full set of craft skills. Many could hope to run their own machine shops, becoming self-employed contractors to assembly firms.[4]

Southeastern Michigan became the center of auto production in part

because skilled workers were concentrated there. Carpenters, woodworkers, painters, and upholsterers worked in the carriage and furniture industries. Pattern makers, molders, and sheet-metal workers came from the stove manufacturing industry. Skilled machinists, molders, and blacksmiths had been in railroad and machine shops. High wages lured these workers into the auto industry: a carriage trimmer got $2 a day, an auto trimmer $4 for roughly similar work.[5]

Early Skilled Workers

Early automotive manufacturing involved four basic production steps: foundry work, machining, body making, and final assembly.[6] Each step required a variety of skilled laborers.

Foundry Work. The first phase, foundry work, required the most skill in early auto factories, and workers undertook it only after extensive apprenticeships. First, a pattern maker hand-carved an exact, three-dimensional wooden or metal replica of the part to be cast, following a blueprint or drawing.[7] Next, a molder made a perfect impression of the wooden pattern by placing it in a box and packing sand around it. It was a complex and skilled job to get the mix of sand and glue correct and to pack the sand uniformly. Then a core maker poured in molten metal, cut air vents and gates in the mold, and located the cores, or solid forms made of sand, inside the mold that made the hollow areas in the casting. A mold was discarded after being used only once.

The molten metal to be poured into the molds was prepared by a founder, who relied on empirical skills to charge the furnace with scrap or pig iron; smelt the iron; add such elements as carbon, manganese, and nickel; remove slag; heat the metal to the desired temperature; and pour the molten metal from the furnace into buckets. A forge operator had to change and adjust the die for each part being forged.

Machining. The second phase of automotive production was machining. Machinists produced finished engine blocks and other parts by grinding, drilling, and buffing rough castings from the foundry. Metal-cutting machine tools were used to finish rough castings and forgings into precision parts. Mechanics had responsibility for making entire parts. Independent companies machined many of the parts. Among the larger suppliers of engines and transmissions during the first decade of the twentieth century, Leland & Faulconer had 500 employees, the Dodge Brothers, 150.[8]

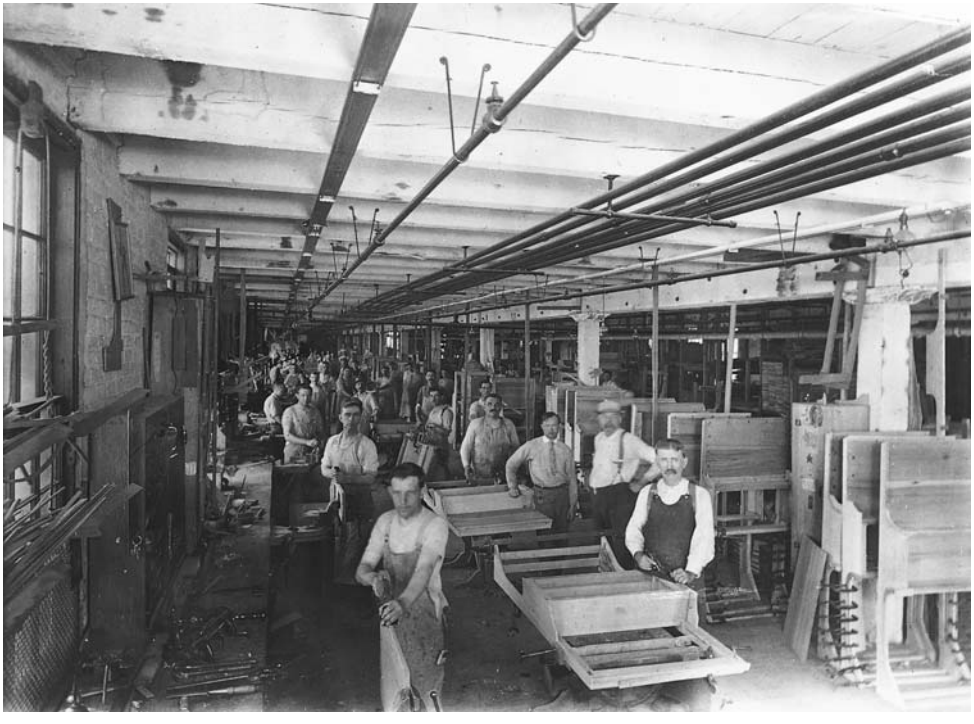
Machinists learned through intuition and experience to adapt lathes, drill presses, and other universal, general-purpose power tools to a variety of tasks. Individual machinists could operate and repair most of the machines in the shop; manufacture of accurate parts depended on the discretion of machinists in selecting the appropriate tools and controlling the action, duration, and direction of each tool.[9]

Suppliers made parts for each manufacturer according to a unique design, leading to a chaotic proliferation of specifications. For example, in 1910 the auto industry used 1,600 different sizes of steel tubing and 135 types of steel, and one supplier made 800 different sizes of lock washers.[10] Even if two manufacturers ordered items to the same specifications, suppliers lacked a standard gauging system to actually specify identical parts, or machine tools capable of replicating the specifications with precision. Under craft production, manufacturers couldn't make two identical cars, even if the vehicles were built to the same blueprint.

Body Making. The third step in the production process was making the bodies. The auto industry inherited basic body-building methods from the horse-drawn carriage industry. Because of high overhead costs and the large number of required skilled workers, many car makers bought bodies from independent suppliers and delayed making their own bodies for several decades, even after other steps in the production process had been vertically integrated. Briggs, the last major independent body supplier, was sold to Chrysler in 1953. Body work was one of the first major components that car makers again turned over to independent suppliers in the 1990s.

Skilled woodworkers and carpenters carved the bodies from wood (Fig. 5.1). In the paint department, up to fifteen coats of clear varnish were applied by brush, and the bodies were sanded and rubbed between coats. After the next-to-last finish coat, the most highly skilled painter—and highest paid worker in the shop—applied striping and detailing. Then the body was finish-varnished and dried. Painting could take a month.

The painted bodies were sent to the upholstery shop, where skilled upholsterers and leather workers stitched leather seat covers and panels for the interior. Trim workers added running board shields, head lamps, luggage racks, and other exterior trim. Metal finishers used files, hammers, and other hand tools to smooth seams in the bodies. Even after pressed sheets of steel and aluminum replaced wood, the body shop remained a sanctuary of skilled workers in the auto plant.



5.1. Body-making shop, Buick assembly plant, Flint, Michigan, c. 1910. In early assembly plants, before introduction of the moving assembly line, skilled workers carved the bodies from wood. (Kettering/GMI Alumni Foundation Collection of Industrial History)

Assembly. The fourth phase was assembly. Mechanics assembled the engine, transmission, and finished car at stationary work stations. Cars were built in small batches; even a large assembly plant that turned out 1,000 vehicles a year produced several models in small batches. It took two workers three and a half days to assemble a car.[11]

Since parts were cast and machined by hand by dozens of outside contractors, when parts arrived at the final-assembly plant, "specifications could best be described as approximate."[12] Final-assembly workers had to adjust each individual part: exhaust, muffler, tail pipe, brake, brake rods, wheels, tires, levers, dash, windshield, fender. Mechanics laboriously filed and ground the ill-fitting components, then drilled, riveted, and bolted them together, using general-purpose machine tools. The most skilled mechanics were therefore assigned to assembly work. Skilled workers fitted

two parts together, then added a third part, and so on. This sequential fitting produced "dimensional creep." By the time a car was finished, it was unique. Of course, having no two cars identical was actually a market asset when only a handful of wealthy people were buying them. Each car could be customized at the plant for the client.

Workers Control the Workplace

Because of their specialized knowledge and skills, craft workers were essential for successful assembly. Workers learned to keep in mind the distinctive peculiarities of each imperfect part and to make adjustments in previous and subsequent operations, taking into account these imperfections.[13]

Their monopoly of mechanical skills and their crucial role in the production process gave workers considerable control over their workplace. They could work at their own pace and determine details of what was done, when, and how fast. Skilled workers had discretion to make important production decisions that determined the accuracy of the output. Even less-skilled assembly workers had some control over their pace of work; as they pushed their bins from car to car, they could slow down to rest or speak, and supervisors could not force a faster pace.[14]

Their ability to set the pace and accuracy of production—and even more critically their scarce availability—gave skilled workers strong weapons in their battle with bosses for control of the workplace in the first years of the auto industry. Owners made decisions about investments and resource allocations, scale of production, product type, and marketing, and they had general control over wages, hours, hiring, and firing. But workers could force higher wages, reduced working hours, and specific job rules. Owners had problems introducing new machinery, such as semi-automatic molding machines.[15]

Union membership increased among automotive workers from 8,000 in 1901 to 14,000 in 1904. Unions published a price list and rules for performing specific tasks and set maximum daily limits on work time and production. Employers agreed to a closed shop—in which union membership was a condition of employment—because they feared that hiring unskilled workers would undermine product quality. Several successful strikes in 1901 secured reduced working hours and increased wages, and encouraged other workers to join unions. Detroit was gaining a reputation as a union town.[16]

But the balance of power between workers and bosses in the auto in-

dustry quickly shifted. Union membership in the auto industry reached 15,000 in 1911, but after a decade of rapid employment growth, that figure represented only 9 percent of 175,000 auto workers. The number of unionized auto workers would decline to virtually nothing during the next two decades.

Deskilling under Mass Production

Deskilling hit the automotive industry rapidly; the process was complete by 1920. Deskilling of the automotive industry work force was triggered by the invention of thousands of new machine tools. When motor vehicle production began, skilled workers had at their disposal only a few general-purpose power tools that had to be carefully operated to achieve the needed accuracy. The new machines permitted greater accuracy and standardization, diminishing the need for individual discretion.

The automotive industry did not invent standardization. Standardized firearms had been manufactured for more than a century. Eli Whitney, who had stimulated textile manufacturing by inventing the cotton gin in 1793, produced muskets for the U.S. Army in 1798 by assembling interchangeable parts manufactured on specialized machines, and he was able to repair the weapons quickly with premade parts. Samuel Colt made thousands of revolvers on highly specialized machines. Albert Eames manufactured interchangeable parts for carbines and pistols, and in 1842 produced a new model percussion musket with standardized parts. In a demonstration before the British military commission in 1853, ten guns were dismantled, the parts were mixed together, and the guns were successfully reassembled from the intermingled collection of standardized parts.[17]

Cyrus McCormick also made farm equipment on a continuous production line. During the first decade of the nineteenth century, Samuel Bentham, March I. Brunel, and Henry Maudslay invented forty-four machines that produced identical wooden pulley ship blocks through a series of specialized operations. Timepieces were first manufactured with interchangeable parts around 1820, and automatic machinery was used for the first time during the 1850s to make watches by consecutive process in a single factory.[18]

Standardization was introduced in the automotive industry for two reasons. One was quality. Luxury models such as Cadillac had standardized parts as a way to fashion the highest quality vehicle possible, rather than to produce it more quickly. Machine tools enabled skilled workers to shape—again, more carefully rather than more quickly—parts that fit together

precisely. Second, standardization helped makers of low-priced models, such as Ford, sell more vehicles, because they advertised the ease with which owners could replace worn-out parts and keep vehicles operating even in rural areas far from big-city dealers.

The use of interchangeable parts was also a necessary precursor to Ford's greatest manufacturing contributions, the moving assembly line and vertical integration. Fifteen thousand machine tools were introduced during the first three years of production at Ford's Highland Park plant. "The Ford machinery was the best in the world, everyone knew it," testified New York investment banker John W. Prentiss in the 1926 Additional Tax Case.[19]

Some of the thousands of new machines were invented by tool companies, others by the auto companies themselves: borers and planers to grind cylinders, machines to mill cylinder castings, steam hammers to forge crankshafts, presses to stamp fenders, lathes and drill presses to work engine cylinder blocks and heads, cradles and jigs to make large quantities of identical shapes. The most important advances in machine tools were those that could work on prehardened metals. As *The Machine That Changed the World* observed, "the warping that occurred as machined parts were being hardened had been the bane of previous attempts to standardize parts."[20]

Each Ford worker in 1903 assembled a large part of one vehicle before moving on to the next. The worker's average "task cycle"—the amount of time spent before repeating the same operation—was 514 minutes. Once Ford had interchangeable parts and specialized machine tools, the average task cycle was reduced to 2.3 minutes. By eliminating the need for workers to walk to perform their task, the moving assembly line further reduced the average task cycle, to only 1.2 minutes.[21]

When Highland Park first opened in 1911, a Ford worker could make one complete transmission cover in 18 minutes, 30 in a 9-hour day. In June 1913 the foreman got permission to set up flat-top metal tables and divide the work into 23 operations. With the help of new machine tools, the 23 workers, specializing in single tasks, could make 1,200 transmission covers in an 8-hour day, the equivalent of each worker building one in 9 minutes, 12 seconds.[22]

Each new machine further increased productivity. For example, a lathe equipped with twelve cams could shape a camshaft for a six-cylinder engine in one operation, rather than in twelve, thereby increasing productivity twelvefold. New machinery also improved accuracy. The heavy produc-

tion grinding machine, introduced by Charles Norton in 1900, made it possible for auto makers to correct distortions in steel parts that resulted when they were hardened by heat treating to make them durable.[23]

The Society of Automotive Engineers rationalized the industry's parts and machines during the 1910s, beginning with standardization of steel products. The society reduced the number of different lock washers from several thousand to 16; steel tubes, from 1,600 to 210; and steel alloys, from 135 to 50.

Motor vehicle production became more specialized, repetitive, and automatic, requiring little thought, judgment, or skill. Tasks were divided into ever more specific pieces. For example, Ford organized engine assembly into 84 distinct steps in 1914. Assembling a motor that used to take 1 worker 9.9 hours, instead took 84 workers a combined total of 3.8 hours.[24] Each worker performed one specialized operation all day. One would ream bearings, 1 every 7 seconds. The next would file bearings, 1 every 14 seconds. The next put bearings on camshafts, 1 every 10 seconds. The 84 tasks were performed on 2 lines (Table 5.1).

Workers could no longer set their own work tempo. The pace, intensity, and quality of production were controlled through the design of machines, their arrangement on the shop floor, and their inspection and record keeping.[25] Precision machining of interchangeable parts made auto production a matter of timed operations rather than of individual ingenuity in getting mismatched pieces to fit together. Logical sequencing eliminated a major source of "discretionary worker movement [that had] made close supervision impossible."[26] The moving assembly line set the speed of work.

The organization of factory work with minimally skilled labor, as found in the auto plants beginning in the 1910s, became known as Taylorism. Frederick W. Taylor, the father of scientific management, came to Detroit in 1909, where he spoke for four hours to Packard executives at the invitation of company president Henry Joy. Taylor argued that the way to break workers' control over production was to remove all possible brainwork from the shop floor and eliminate the need for most skilled workers. Management should redesign every job and divide it into dozens of simple, repetitive tasks capable of being performed by unskilled laborers or semiskilled machine operators. As the work tasks were deskilled, most skilled craft workers could be replaced.

Taylor began in 1881 to keep careful time and motion studies of workers in the machine shop of the Midvale Steel Company in Philadelphia, where he was a supervisor. In 1893 he opened a consulting office in Philadelphia

TABLE 5.1. Worker Tasks on Ford's Highland Park Engine Assembly Lines, c. 1915

Task	Number of Men	Seconds per Man
Tasks 1–28 were performed on the first line:		
1 Put cylinder on hot plate and plug holes with asbestos	2	6
2 Put cylinder on babbitting fixture	1	4
3 Put on babbitting bar and plates	1	7
4 Pour babbitt	1	4
5 Take off babbitt bar and plates	2	6
6 Take off cylinder	1	3
7 Chop gates	1	12
8 Peen babbitt	1	11
9 File gates	1	15
10 Wash cylinders	2	18
11 Clean out chips and wash out babbitt chips	1	5
12 Put in broaching tools in 8 push-rod guide holes	1	30
13 Take cylinder from rack and broach 8 holes in punch press	1	13
14 Seat 8 valve seats in 8-spindle press	1	101
15 Put in valves in motor while other one grinds valves	1	71
16 Wash and inspect valves	2	32
17 Steam cylinder and blow out with 72 steam jets	2	33
18 Put valves back in cylinder	1	8
19 Assemble springs and spring seats to motor	4	21
19.5 Water-test cylinder	1	1
20 Assemble valve-spring seat pins	1	45
21 File burrs from cylinder case and gauge holes with bolts	1	14
22 Assemble front and center bearing with liners and bolts	1	20
23 Assemble rear cap and bolts and put on 2 nuts	1	25
24 Tighten nuts on front bearing and put 2 nuts on center bearing	1	25
25 Tighten center-bearing bolt nuts	1	24
26 Tighten main bearing and take case from bench	1	21
27 Take cylinder from line; in lathe, ream, put on slide (or 2 x 98)	1	160
28 Round corners of bearings	1	35
Tasks 29–84 were performed on the second assembling line:		
29 Take off caps, punch oil holes, countersink and mark caps	1	124
30 File angle on bearing, wipe out dirt & chip gear cover, lay crank in place	1	100

TABLE 5.1, *continued*

Task	Number of Men	Seconds per Man
31 Oil-stone crankshaft and fit liners below bearing caps	1	100
32 Put in 6 bearing bolts, tighten nuts on main bearing bolt	1	115
33 Tighten front bearing nuts and one center bearing nut	1	105
34 Put in cotter pins and clean out front-cover end with wire brush	1	100
35 Run in crankshaft	2	105
Operations 36–43 place the camshaft and gear assembly and are worked on a bench:		
36 Ream bearing	1	7
37 Break bearing	1	10
38 File bearing	1	14
39 File off burrs on camshaft flange	1	9
40 Assemble front bearing to camshaft	1	10
41 Assemble spring to bearing and assemble center bearing	1	14
42 Assemble gear to camshaft	1	44
43 Test out size of camshaft gear	1	10
44 Drive brass bushing in case and line-ream it	1	70
45 Assemble push-rods in push-rod guides	1	52
46 Drive camshaft in cylinder and blow out motor	1	53
47 Put in cam-bearing, set screw, take push rods from below valves	2	60
Piston and rods assembling is a separate job, on piston-and-rod assembling bench:		
48 Gauge pin bearing on crankshaft, scrape off burrs on cylinder bores	1	57
49 Fit pistons	3	70
50 Fit rings to pistons	1	24
51 Stone burrs on crankshaft pins and turn over motor	1	85
52 Mark caps on rods and retry pistons, pull wire from water jacket	1	28
53 Take off caps and file them	2	106
54 Put on 2 top rings and push pistons in cylinder	1	50
55 Pull No. 1 and No. 4 rods to crank pin, put on nuts and cotter pins	1	60
56 Turn over crank, assemble No. 2 and No. 3 rods and caps to crank	1	63
57 Assemble nuts and cotter pins to No. 2 and 3 rods, take motor off bench	1	75
58 Belt piston in belting-out stand. Run in pistons in cylinders	2	55
59 Time motor. Separate bench operation	1	355
60 Drive 6 studs by machine	1	45

TABLE 5.1, *continued*

Task	Number of Men	Seconds per Man
61 Clean cylinder and put on head and gasket and drive 15 bolts	2	58
62 Tighten 15 cylinder-head bolts and put in 4 bogus plugs	1	56
63 Put on magneto coil	1	51
64 Wire coil and put in oil tube and clamp and gauge coil	1	38
65 Assemble cylinder front cover	1	50
66 Hand transmission	—	235
67 Assemble fan pulley	1	60
68 Assemble commutator	1	80
69 Inspect motor and blow out valve doors	1	53
70 Blow out motor. One man takes care of 2 lines	—	25
71 Put on bands, universal ball cap, pan on motor and put in pan bolts	2	61
72 Tighten bolts with electric drill and turn motor on ways	2	65
73 Put 2 front-cover bolts in pan, put transmission-cover gasket on cylinder	1	78
74 Assemble transmission cover to motor and put in 2 rear bolts	1	70
75 Tighten engine-pan bolts and put in cotter pins	2	75
76 Adjust bands	1	60
77 Put in transmission cover-to-pan bolts and put on nuts	2	70
78 Tighten transmission cover-to-pan bolts, put in cotter pins and oil	2	72
79 Assemble slow-speed connection and adjust it	1	67
80 Put exhaust & intake pipe clamps & 6 screws in transmission-cover door	1	55
81 Assemble magneto contact and tighten transmission-cover-door screws	1	71
82 Assemble exhaust and intake pipes with carburetor	1	50
83 Put on side and top water connections	1	55
84 Paint motor—remove from line	1	68

Source: Adapted from Arnold and Faurote, *Ford Methods and the Ford Shops,* pp. 118–27.

specializing in shop management and manufacturing costs. By the time he was invited to speak to Packard executives, he was considered the nation's leading consultant on productivity and worker output. His seminal work on the subject, *The Principles of Scientific Management,* was published in 1911, the first full operating year for Ford's Highland Park plant.

Taylor's views had a major impact on Packard executives, who immediately instituted a Taylor-inspired analysis of jobs at their factory. But when

Taylor next returned to give a speech in Detroit in 1914, he was told that several auto companies had anticipated his ideas and had gone ahead with similar plans without knowledge of Taylor's work.[27]

In the automotive industry, structural changes that led to deskilling the labor force predated Taylorism. Motor vehicle producers didn't go out looking for a way to deskill labor; the application of Taylorist principles came later in the deskilling process. It was the new machinery that tipped the balance of power in favor of management. Taylorism later gave managers an organizational structure to adopt that reflected the new work relationships.

Organizational changes in response to the availability of new machinery completed the task of removing from workers the need to perform skilled operations. Management could assign to each worker a very specific, specialized task, for which the worker could be quickly trained. Subsequent improvements in machinery and organizational studies made it even easier for an individual to perform a task with minimal training. As the need for distinctive skills diminished, automotive workers lost their ability to influence workplace conditions.

Immigrants Supply Unskilled Labor

Workers naturally resisted the loss of control over their workplace, but they failed. The first great battle in the auto industry between labor and management was over by 1907, and labor had lost. Failed strikes by the molders', metal polishers', and machinists' unions in 1907 marked the end of organized labor in the early automotive industry. The strikes were broken when companies hired foreign-born workers who arrived with a police escort. Detroit now had an international reputation as a city of docile labor.[28]

Changing technology tipped the balance of power away from skilled workers, although the rapid rate of transformation of Detroit's labor climate resulted from a deliberate campaign by the city's leading employers. The Employers Association of Detroit (EAD), formed in 1902, led the successful campaign to convert Detroit to an open-shop town. Henry M. Leland was one of its founders, and the Olds Motor Works and Briscoe Manufacturing Company were members.

Companies fired union employees and refused to renew closed-shop agreements between 1903 and 1907. Inevitably, these firings provoked dozens of strikes. To break strikes against member firms, the EAD secured court injunctions from sympathetic judges to prevent picketing. Enforcing

the injunction, police would break up picket lines and arrest union leaders, and the EAD would supply the companies with replacement strikebreakers. The EAD also fought against unwanted legislation requiring plant inspections, regulating plant safety, and restricting use of child labor.

To supply member firms with workers who would not be "troublemakers," the EAD established a labor bureau. The EAD Labor Bureau had files on 40,000 people in 1906—nearly half of Detroit's work force—documenting circumstances under which they had been hired and fired. By 1911, 160,000 out of Detroit's total work force of 175,000 were on the EAD list. Because member firms avoided hiring workers who had been fired for union activities, the EAD Labor Bureau records amounted to a blacklist of union activists. The EAD planted spies in the factories of member firms, as well as in the unions, to make sure that the files on individual workers were accurate.[29]

Despite the deskilling of the labor force, the introduction of time-saving machinery, and the campaign of the EAD, automotive workers in the first decade of the twentieth century still had one remaining weapon against management: the number of workers, skilled or unskilled, was growing at a slower rate than the demand for cars. Labor of any sort was in short supply in southern Michigan.

Michigan's early automotive workers were not fresh recruits to industrial labor; rather, they had experience doing similar work in other industries. Their parents and grandparents had become industrial workers in the United States after migrating from the United Kingdom and Germany, as well as Canada, Ireland, and Poland.[30] When the rapidly growing auto industry had soaked up the supply of experienced industrial workers of Western European descent, the EAD had to tap into new sources of labor. When it figured out how, workers' loss of power was complete. To meet the growing demand for workers, the automotive industry looked overseas. This was the period of the highest immigration rates to the United States, an average of nearly 1 million people per year between 1900 and 1915. In the record year of 1907, when 1.3 million people came to the United States, the Detroit Board of Commerce asked immigration officials at Ellis Island to steer foreign workers to Detroit.[31]

In the early twentieth century more than 90 percent of the immigrants to the United States were European. But instead of coming from the United Kingdom, Ireland, and Germany, as had been the case in the nineteenth century, most now came from southern and eastern Europe. Nearly one-

fourth each came from Italy, Russia, and the Austro-Hungarian empire, which encompassed portions of present-day Austria, Bosnia-Herzegovina, Croatia, Czech Republic, Hungary, Italy, Poland, Romania, Slovakia, Slovenia, and Ukraine. Most of the remainder came from smaller countries in southern and eastern Europe.

These immigrants from southern and eastern Europe came to the United States for the same reason as earlier immigrants from northern and western Europe—and more recent immigrants from Latin America and Asia. The shift in the primary source of immigrants coincided with the diffusion of the industrial revolution. The population of southern and eastern European countries grew rapidly around 1900 as a result of improved technology and health care. For many, the option of migrating to the United States offered the best prospect for prosperity.

According to the 1910 U.S. census, taken at the peak of immigration, 13 million U.S. residents (14 percent of the population) either were born in a foreign country or had at least one foreign-born parent. In Detroit 74 percent of residents were immigrants or children of immigrants (345,000 out of the city's total population of 466,000).[32]

Ethnicity determined which motor vehicle factory would offer the new arrivals a job. Ford's Highland Park plant attracted Finns, Yugoslavs, Romanians, and Lithuanians who had moved into nearby neighborhoods. Workers at the Dodge Main plant in Hamtramck were heavily Polish, reflecting the ethnic character of the surrounding neighborhood.[33] Most regular hiring was done by plant foremen, who naturally favored family, friends, and others of the same nationality. As a result, entire departments were dominated by the ethnicity of the foreman. Few companies had centralized personnel offices to handle regular hiring, and they relied on the EAD primarily for strikebreakers and temporary employees for peak production periods.

Individual ethnic groups dominated some crafts; for example, most tool-and-die makers in the auto plants were Scots. In other cases, comparable departments in two plants were dominated by different nationalities: stamping operators could be Poles in one auto plant and Hungarian in another.

The diversity of languages was a major problem in the car plants. When Ford was installing the moving assembly line at Highland Park in 1914, nearly half of the plant's workers spoke no English, so safety signs for the new equipment had to be posted in eight languages. Seventy percent of the

plant's workers were foreign-born, from twenty-two countries.[34] Political leaders, notably former president Theodore Roosevelt, argued that the key to the Americanization of immigrants was to get them to use English.

Having hired a work force with little knowledge of the English language or industrial skills, Ford Motor Company opened the English School in 1914 and a technical school in 1916. Ford workers who spoke little English were required to attend the English School for six or eight months before or after work, and they could be discharged for not making reasonable efforts to learn the language. The principal teaching method was group recitations, frequently concerning the factory system and the accomplishments of Ford—both the man and the company.[35] Graduates of the English School automatically qualified for the language portion of the examination for becoming naturalized U.S. citizens.

Some of the labor shortage was met domestically through large-scale migration from the rural Midwest and South. The EAD placed advertisements in 191 U.S. papers in 1910, and attracted more than 20,000 workers to Detroit, half of whom found jobs through the EAD Labor Bureau. Detroit had 87,000 more men than women in 1920, many living in lodging houses and hotels near the factories or on the lower east side.

African Americans migrated to Detroit from the South in especially large numbers during the 1910s and 1920s. The African American population in the Detroit area jumped from fewer than 6,000 in 1910 to 41,000 in 1920 and 120,000 in 1930. One thousand African Americans a week arrived in Detroit by train from the South.

As a result of immigration from abroad and from the rural South, Detroit's total population increased from 285,704 in 1900 to 465,766 in 1910 and 993,678 in 1920. The city reached a peak of 1.9 million in 1950. By 2000, the population had dropped once again, to under 1 million, a result of decline in automotive employment. Meanwhile, Detroit's suburbs grew from 1.2 million in 1950 to 4.4 million in 2000. As a legacy of longstanding patterns of ethnic and racial segregation, Detroit in 2000 was 75 percent African American, its suburbs 90 percent white.

The Great Depression and the Rise of the UAW

In 1929, the year the stock market crashed, Americans bought a record 4.3 million cars and light trucks. With the onset of the Great Depression, sales dropped to 3.0 million in 1930, 2.2 million in 1931, and 1.3 million in 1932. Employment in Detroit-area motor vehicle plants declined from 475,000

in 1929 to 350,000 in 1930 and 250,000 in 1931. Unemployment in Michigan reached 46 percent in 1933.

Poor Working Conditions

Those still at work were the lucky ones—or were they? Most of those still employed had their wages cut or could work only part time. Henry Ford's $5 day, which had risen to $6 or $7 during the 1920s, fell to $3 or $4. Average annual earnings for Michigan auto workers dropped from $1,600 in 1929 to less than $1,000 in 1932, during a period when consumer prices declined only 20 percent.[36]

Workers were at the mercy of foremen who had the power to hire and fire them. The foremen could act capriciously, show favoritism, and demand kickbacks and bribes. Whistling, singing, smoking, talking, and conversing were prohibited in the plants, as was going to the toilet without permission. Workers got fifteen minutes for lunch, including time for washing-up and walking to and from the lunch wagon. Even smiling was dangerous, and workers learned to communicate by hand signals or the "Ford whisper."[37]

Monotony took its toll in mental and physical exhaustion. Especially oppressive was the speeding up of the line, which exhausted younger workers and forced out "older" workers (those over forty). Detroit lawyers referred to "the Ford client" as someone who looked sixty-five but turned out to be fifty.[38] Workers were not paid for disability.

In even worse shape were workers at parts plants, who were often paid by the piece. Because pieceworkers were not paid when the line was down, they had to spend as much as fourteen hours in the plant to earn several hours' wages.[39]

Harry Bennett's Service Department maintained order at Ford. Bennett's private army of 3,000 armed ex-cops, paroled convicts, boxers, wrestlers, gangsters, and retired sports stars "evolved into an engine of repression and regimentation for which no exact contemporary parallel can be found in any comparable locality in the United States. . . . It was the proud, undisguised aim of the Service Department to blot out every manifestation of personality or manliness inside a Ford plant."[40] The Service Department maintained order "by a degree of physical terror alien to all concepts of a democratic society."[41] Bennett himself was proud that his Service Department thugs were so thorough that "employees were even followed to the toilets."[42]

More sensitive than Ford to its corporate image, General Motors avoid-

ed overt violence to repress workers. Instead, it hired the Pinkerton Detective Agency to create an atmosphere in which workers were afraid to participate openly in union activities, and every other worker was suspected of being a spy. Still, in case of violence, GM stockpiled teargas at the homes of plant managers.

New Deal Encouragement

If the Great Depression gave organized labor its most compelling reason to exist, the New Deal, following the inauguration of Franklin D. Roosevelt as president on March 4, 1933, gave the movement its most important opportunity to succeed. Under the National Industrial Recovery Act (NIRA), enacted June 16, 1933, the country's major industrial sectors, including the automotive industry, were required to draft codes of fair competition in consultation with representatives of labor and consumer groups. Industries were permitted to write codes that fixed prices and set production quotas exempt from antitrust laws—as long as they also agreed to improved working conditions, including a higher minimum wage, a shorter work week, and the abolition of child labor. Most important for the labor movement, Section 7(a) of the NIRA guaranteed workers the right to "organize unions of their own choosing" for collective bargaining. During the two years that the NIRA was in effect, 550 industry codes were approved, covering 2.3 million employers and 16 million workers.

Automotive producers reluctantly prepared a code, fearing that the public, which strongly supported the NIRA, would view them as unpatriotic. General Motors proudly displayed the NIRA symbol, the "Blue Eagle," in its advertising; at the same time, however—along with its largest shareholder, DuPont—GM contributed much of the financial support to the American Liberty League, founded in 1934 to oppose the NIRA and other New Deal legislation and to fight (unsuccessfully) President Roosevelt's reelection in 1936. Henry Ford refused to sign the code at all.

In 1935 the U.S. Supreme Court unanimously found the NIRA unconstitutional, in *Schechter Poultry Corporation v. the United States* (295 U.S. 495). The NIRA's attempt to fix hours and wages could not be justified as part of the federal government's right to regulate interstate commerce and was an invalid exercise of power over intrastate commerce. Six weeks later, on July 5, 1935, President Roosevelt signed the National Labor Relations Act (NLRA), substantially strengthening the federal government's commitment to collective bargaining. Commonly called the Wagner Act, after its chief sponsor, New York senator Robert F. Wagner, the NLRA guaranteed

the "free exercise by employees of the right to bargain collectively through representatives of their own choosing." The act declared that it was U.S. policy to remove impediments to collective bargaining, because these impediments caused strikes and therefore obstructed interstate commerce.

Under the Wagner Act, employers could not discriminate against employees or discharge them for union activities, nor could they restrict or interfere with organizing efforts. If the majority of its employees voted for a union to serve as their exclusive representative, a company was obligated to bargain with it in good faith. The National Labor Relations Board (NLRB) was empowered to investigate charges of unfair practices, including the power to subpoena witnesses; to issue findings of unfair labor practices by companies or unions; and to enforce the findings by initiating suits in federal district court against the alleged offenders.

In 1937 the U.S. Supreme Court upheld the Wagner Act by a narrow 5–4 margin in *NLRB v. Jones & Laughlin Steel Corporation* (301 U.S. 1). The structure created by the Wagner Act for resolving labor disputes remains in effect today with several modifications—most notably the Taft-Hartley Act, passed in 1947 over the veto of President Truman, which permitted states to pass "right to work" or "open shop" legislation.

Early Union Efforts

Even as it gained more federal protection of the rights to organize and bargain, the labor movement split during the 1930s. The division was between craft unions founded in the nineteenth century to represent skilled workers, and industrywide unions recently created to organize unskilled, mass production workers. The automotive industry was at the center of this split within the labor movement. Should all auto workers join one union, or should workers performing different tasks, such as machining, painting, and upholstery finishing, join separate unions?

In the nineteenth century, when manufacturing took place in small shops with simple technology, highly skilled workers joined unions that represented their trades, a conceptual outgrowth of medieval craft guilds. Several skilled craft unions formed the American Federation of Labor (AFL) in 1886. The AFL operated under the principle of exclusive jurisdiction, in which each member union had a chartered claim to all workers practicing its particular craft.

Recognizing that carriage builders represented a distinct trade, the AFL chartered the International Union of Carriage and Wagon Workers in 1891. As motor vehicles replaced horse-drawn vehicles, many carriage workers

transferred their skills to automotive production. Representing several thousand automotive industry workers, the union changed its name to the International Union of Carriage, Wagon, and Automobile Workers in 1912. Other AFL unions opposed its expansion into the motor vehicle industry because they wanted automotive workers divided among several craft unions instead. When the union refused to drop the word *Automobile* from its name, the AFL suspended it in 1917 and expelled it a year later. As an independent organization, the union adopted the name Auto Workers Union (AWU).

At its peak in 1919 the AWU represented 45,000 of the nation's 343,000 automotive workers, yet only three years later its membership had declined to 800, primarily because of a series of failed strikes. The steep decline was also partly due to the introduction of DuPont's Duco paint, which eliminated many jobs in the finishing departments of the body plants, where the AWU was strongest.[43] Communists took over the union in 1925 and affiliated with the Communist-dominated Trade Union Unity League. AWU membership grew to 3,000 members in 1926, but then declined to under 100 in 1930; the Communist Party dissolved the union in 1934.

The Industrial Workers of the World (IWW), which preferred attacking capitalism rather than engaging in collective bargaining, also tried to organize early automotive workers. National membership in the IWW among all workers reached a peak of perhaps 100,000 during the 1910s, but only a few hundred auto workers ever joined. The government suppressed several IWW strike attempts during World War I, and the union rapidly lost influence after the war.

The most successful auto workers' union during the first years of the Great Depression was the Mechanics Educational Society of America (MESA), established in 1933. MESA represented 35,000 auto workers, including more than 90 percent of the industry's tool-and-die makers, as well as some semi-skilled metal workers. The name "educational society" was deliberately chosen to mislead companies into believing that the organization's purpose was to improve trade skills.[44]

Tool-and-die makers created specialized parts for the cutting, stamping, and grinding machines that were used to shape metal automotive components, such as doors, hoods, and fenders. Toolmaking was one of the last skilled trades in the auto industry, and the tool-and-die makers regarded themselves as aristocrats among factory workers. But the trade had fallen on hard times during the Depression, along with the rest of the auto in-

dustry. Average annual earnings had declined from $2,433 in 1929 to $636 in 1933, with wages depressed by a contracting system in which workers bid as little as 20¢ an hour in order to obtain scarce work.

Under the leadership of Matthew Smith, MESA launched a strike on September 21, 1933, that shut most of the tool-and-die shops during the retooling of factories for new models, when the skills of diemakers were most needed. The union secured only modest wage increases, but the settlement represented the first important break in manufacturers' resistance to collective bargaining.

Two other unions organized Detroit-area plants during the early 1930s. The Automotive Industrial Workers' Association (AIWA), led by Richard Frankensteen, represented 24,000 auto workers, including most employees of Chrysler's Dodge Main plant in Hamtramck. Support from the nationally influential, inflammatory, Detroit-based radio priest Father Charles E. Coughlin was instrumental in AIWA's growth. Much smaller was the Associated Automobile Workers of America (AAWA), a union of workers at Hudson's Detroit plant. Its head, Arthur Greer, was "a company stooge and probably a member of the fascist Black Legion."[45]

Proud of their skilled crafts, AFL leaders scorned the masses of unskilled auto workers and made only half-hearted attempts to organize them. AFL head William Green was called "Sitting Bill" by impatient industrial unionists, and William Collins, head of the AFL's auto industry organizing campaign, proudly proclaimed, "I never voted for a strike in my life."[46] Collins's successor, Francis Dillon, has been described as "a conservative and colorless unionist, [who] specialized in a rather turgid sort of oratory."[47] The AFL's monthly journal *The Federationist* accepted advertising from General Motors and other notoriously anti-union companies.[48]

To recruit unskilled workers in the mass production industries, the AFL in 1926 created so-called federal labor unions (FLUs). These were designed to represent unskilled workers temporarily, until they could be assigned to craft unions.[49] FLUs gained recognition at nine automotive plants, though none in Michigan, heart of the automotive industry. An FLU strike at GM's Chevrolet transmission plant in Toledo, Ohio, in April 1935 resulted in recognition of the union as the bargaining agent for the plant. Within six months of the settlement, however, GM laid off 900 workers at Toledo and moved half of the plant's machinery and many of the foremen to a nonunion plant in Saginaw, Michigan.

A national council of auto industry FLUs asked the AFL Executive Council on February 1, 1935, to charter an international union covering all

auto workers, to be called the United Automobile Workers of America (UAW). President Green agreed to call a convention to create the union, but to mollify opponents in the building trades industries, he postponed the convention until August 1935 and limited the UAW to organizing only those workers who actually operated the assembly line, rather than all workers in the auto plants.

When it came time to elect the UAW's first president, convention delegates refused to endorse Green's choice of the "conservative and colorless" Francis Dillon, but Green appointed him anyway. At the second annual UAW convention, in April 1936, members again rejected Dillon and instead selected as president the union's vice president, Homer Martin. At that point AFL leaders walked out of the UAW convention and suspended the union. The United Automobile Workers soon became a bit more "united" when the AIWA, AAWA, and two Detroit MESA locals disbanded and joined the UAW instead.

Disaffected leaders of the UAW and other unions created the Committee of Industrial Organizations (CIO) in late 1935 to work for AFL acceptance of industrial unionism. When the AFL suspended the UAW and nine other unions in 1936, leaders of those unions transformed the CIO from a committee within the AFL into an independent organization, with affiliated unions established by industry rather than by craft. In addition to the UAW, early members included the Amalgamated Clothing Workers; Flat Glass Workers; Iron, Steel & Tin Workers; Ladies' Garment Workers; Mine, Mill & Smelter Workers; Oil Workers; Rubber Workers; Textile Workers; and United Mine Workers. In 1938 the CIO changed its name to the Congress of Industrial Organizations.

UAW Success

When the UAW joined the breakaway CIO in September 1936, its chances of success seemed small: "a moderately conservative bookmaker . . . might have offered 100 to 1 odds against the union, but this was the season for long shots."[50] Astonishingly, within six months the UAW had successfully organized the world's largest corporation.

The UAW's first major success in Detroit came in late 1936. Detroit Midland Steel's 1,200 employees stopped work on November 27 to demand recognition of the UAW as their sole bargaining agent, the abolition of payment for piecework, and a wage increase of 10¢ an hour. Midland capitulated to all three demands on December 4, under pressure from Chrys-

ler and Ford, which had to lay off 100,000 workers because of a shortage of body frames.

Most significant was the UAW's tactic to achieve the Midland victory: the sit-down strike. At 11:30 A.M., the 1,200 Midland employees halted work and barricaded the plant, preventing the entry of the police and the Ford Service Department men sent to collect frames. During the eight-day strike, the men sang, played cards, tossed a football, and did calisthenics. To forestall any hint of scandal, the 200 female workers were asked to leave the plant rather than stay overnight. The women set up a kitchen at nearby Slovak Hall to feed the men and paid visits of reassurance to the wives of the men inside the plant.

The tactic of the sit-down strike was not new—the IWW had used it at General Electric in 1906—but it became the most distinctive form of expression of the strength of the workers' grievances and the desperation of their plight during the Depression. The first major, Depression-era sit-down strike had taken place at the Hormel Packing Company in Austin, Minnesota, in 1933.[51] The rubber workers adopted the tactic in early 1936 in Akron, Ohio, tire plants; the U.S. Bureau of Labor Statistics recorded 48 sit-down strikes, involving 87,817 workers, that year. Under the influence of the auto workers, the number of sit-down strikes increased in 1937 to 477 strikes, involving 398,117 workers, before decreasing in 1938 to 52 strikes, involving 28,749 workers.

The sit-down strike dramatically changed the balance of power between workers and corporations. Compare the scenario to a typical strike, in which strikers left their plant to face the bleak prospect of walking a picket line in extreme weather conditions, while the company hired replacement workers desperate for jobs during the Depression. If necessary, police and national guard troops escorted the departure of completed work past the picket line and the arrival of new supplies and replacement workers into the plant. In contrast, the sit-down strike effectively shut down plant operations, leaving company officials, replacement workers, and the police outside in the cold, while striking workers inside prevented the arrival of supplies or the departure of finished products. Not even the most staunchly anti-union company dared risk the wrath of public opinion by implementing the only strategies that could possibly break the sit-down strike: either convince law enforcement officials to launch a bloody assault or else starve the workers out by preventing their wives from delivering food. Employers argued with justification that the sit-down strike was an

illegal seizure of property. The U.S. Supreme Court agreed in 1939. But by then the use of the tactic had waned, after major successes had been achieved, notably in the automotive industry.

Through 1936 UAW leaders debated which of the Big Three motor vehicle producers to go after first. Ford, with its heavy reliance on violence and terror, clearly had to be last, so the choice was between Chrysler and General Motors. Chrysler appeared the more logical choice, because Walter P. Chrysler was relatively progressive, at least by automotive industry standards, and less rabid in his opposition to collective bargaining. Chrysler's largest plant, Dodge Main, had already been organized by the AIWA, and the company was growing fast, having moved into second place in sales in 1936, ahead of Ford.

Yet the UAW went after General Motors first, and even more improbably, made its stand in GM's hometown of Flint. General Motors employed four-fifths of Flint's total labor force (one-fourth of Flint's 150,000 residents, including children and the elderly). The world's largest auto maker directly controlled or at least strongly influenced Flint's only daily newspaper, its major radio station, school system, relief organizations, and churches. GM directly supervised the city's police force, the mayor was a former Buick paymaster, and other important office holders were current or past GM officials or stockholders.[52]

GM's control of Flint even extended to the local UAW. Of the thirteen members of the Flint union executive board, at least three were known by the national UAW leaders to be GM agents, and at least two were Pinkerton employees. With GM spending nearly $1 million on espionage, "the UAW had the doubtful distinction of being the most infested union in the American labor movement."[53] To organize Flint, the national UAW had to work around its own local executive board.

UAW strategy was to call strikes in early January 1937 at two plants: Fisher Body in Cleveland and Fisher One in Flint. Striking those two plants would paralyze GM's operations, because Fisher Cleveland was the only plant possessing dies for stamping out Chevrolet's redesigned 1937 "turret top" bodies, and Fisher One had the only dies for the new bodies for GM's four other car divisions. The union wanted to wait until after January 1, because a strike before Christmas would be too stressful for workers and their families, and would deprive them of an $80 Christmas bonus that GM was scheduled to pay on December 18. In addition, Frank Murphy, the new governor of Michigan, who would be inaugurated on January

1, was much more liberal and sympathetic to labor than the outgoing governor, Frank Fitzgerald.

The UAW had difficulty keeping impatient workers on the job through the end of 1936. Emboldened by the landslide reelection of President Roosevelt on November 3, 1936, the UAW recruitment campaign came out into the open in Flint and other cities. Workers openly wore union buttons and signed up new members in the plants. Seven short-lived strikes were called in one week at Fisher One to protest line speed. Sit-down strikes achieved UAW recognition at the Bendix Corporation in South Bend, Indiana, during November 1936, and at Kelsey-Hayes Wheel Company and Midland plants in Detroit in December. Strikes at Fisher Body plants in Atlanta in November and in Kansas City in December threatened to spread to other GM plants before the UAW was ready in Flint.

The UAW's penultimate strike at GM actually began on December 28, 1936, in typically haphazard fashion. A strike over a reduction in piece rate in one department at Fisher Cleveland quickly swept through the entire plant, and 7,000 workers sat down. The inexperienced local union leaders, caught by surprise, were pressured by GM and city officials to settle the strike locally, but national UAW leaders blocked a quick settlement by taking the position that the UAW would negotiate with GM only on a national basis—something GM was not yet prepared to do.[54]

GM forced the union's hand at Fisher One on December 30 by loading critical dies onto railroad cars in order to move them to another plant, apparently in Pontiac or Grand Rapids. The workers voted during their lunch break to strike immediately at Fisher One, as well as at the smaller Fisher Two plant, located two miles away, part of the Chevrolet complex. The strike spread to GM's Guide Lamp plant in Anderson, Indiana, and the Chevrolet transmission plant in Norwood, Ohio, the next day; to the Chevrolet transmission plant in Toledo on January 4; to the Chevrolet and Fisher Body plants in Janesville, Wisconsin, on January 5; and to the Cadillac plant in Detroit on January 7.

GM got Genesee County Circuit Court judge Edward Black to issue a restraining order on January 2, 1937, requiring the strikers to evacuate the Fisher One plant and cease picketing. But the injunction was rendered worthless to GM when the UAW demonstrated that Judge Black probably had violated Michigan law by hearing a case in which he had a personal interest—ownership of 3,365 shares of General Motors, worth $219,900.

The sit-down strikers settled into a routine inside Fisher One. The day

included two three-hour periods of strike duty—such as picketing at the gate, patrolling the building, and cleaning—separated by two nine-hour periods off duty. The long waking hours off duty were spent playing ping pong, cards, or checkers, or engaging in boxing, wrestling, and football. Classes were held in labor history and parliamentary procedure. Sympathetic entertainers came in to perform, and country music was piped over the plant's loudspeakers. Three hot meals a day were brought in from a restaurant rented by the union across the street from the plant, with the help of female workers and wives of the sit-down strikers. The men lived in groups of fifteen in different sections of the plant. The lucky ones got to sleep on seats or cushions destined for the car bodies that were partially assembled when the strike began. The strikers made a special effort to keep the plant clean and safe. Men took showers every day, kept their sleeping areas tidy, and removed refuse. The union asked GM to remove 1,000 acetylene torches as a precaution, and the strikers kept the ventilator in the paint department running to remove fumes. Guards kept an eye out for live cigarette butts. After a raucous New Year's Eve celebration, alcohol was banned.

The first violence came at the small Fisher Two plant. Far less critical than Fisher One to GM operations, Fisher Two had only 100 sit-down strikers, who occupied the second floor while, curiously, GM guards controlled the building's gates and first floor. When union volunteers arrived at the main gate on January 11 with dinner, GM guards refused to let them through. Picketers outside the building placed a 24-foot ladder against the building to deliver the food directly to sit-down strikers on the second floor, but guards seized the ladder and shut off the building's heat. Inside the building, twenty strikers armed with home-made clubs went downstairs and ordered the guards to leave the building. Frightened, the guards locked themselves in the ladies' room. Strikers opened the gates and established contact with the outside pickets. City police soon arrived and hurled gas grenades into the crowd, dispersing the outside picketers and forcing the sit-down strikers back into the plant. The police retreated when the wind blew the gas back toward them, and the men inside the plant threw 2-pound car door hinges at them and sprayed them with water from high-pressure steam hoses. A second police advance was also repelled, but not before the police shot and wounded fourteen strikers, one seriously.

The next day, the mayor of Flint asked Governor Frank Murphy to call out the National Guard. Murphy's decision proved to be decisive in the strike's ultimate outcome. He called out 1,200 National Guard troops

(eventually 3,454), but sent them to an abandoned schoolhouse rather than to the plants. Troops would be used to protect the safety of the workers inside the buildings, rather than to evict them.

Murphy had been a Recorder's Court judge in Detroit for seven years, then mayor of Detroit (1931–33). President Roosevelt appointed Murphy governor general of the Philippines in 1933, but convinced him to return to the United States to run for governor of Michigan in 1936. Fearing a tough reelection campaign, Roosevelt thought that having Murphy on the ticket would help him carry a traditionally Republican state. In the end, Roosevelt won in a landslide—forty-six of forty-eight states—and carried Michigan by a larger majority than Murphy.

Michigan's new governor, in office for only twelve days, came to Lansing with a reputation as a strong supporter of civil liberties and workers' rights. As mayor during the early years of the Depression, while the Hoover administration did little nationally, Murphy had turned closed motor vehicle factories into homeless shelters, opened feeding stations, held up evictions of tenants who couldn't pay rent, recognized a municipal workers' union, and honored picket lines. He had issued a permit allowing 50,000 people to march through Detroit in the funerals of four workers who had been killed by Ford guards and Dearborn police in the Hunger March on March 7, 1932, a demonstration of several thousand outside the Ford Rouge factory complex.

Although a friend of organized labor, Murphy was not as distrusted by management as other prolabor politicians were. For one thing, Murphy was friendly with automotive industry executives, including Walter P. Chrysler and Lawrence P. Fisher (Fisher was still in charge of the Fisher Body Division, which in the 1930s retained considerable autonomy within GM). Murphy was a very rich man, and owned GM stock worth more than $100,000, which he sold on January 18, a week after intervening in the strike. GM may not have known that he was a stockholder because the shares had been in a broker's account.

The grandson of Irish immigrants, Murphy aspired to be the first Roman Catholic president of the United States. It was not to be, but a grateful Franklin Roosevelt brought him to Washington as attorney general in 1939, after he lost his bid for reelection as Michigan governor. Roosevelt elevated Murphy to the U.S. Supreme Court in 1940, where he cast a reliable liberal vote until his death in 1949.

To regain momentum, the UAW dramatically seized a third plant in Flint on February 1—Chevy 4, a very large plant that made all of Chevro-

let's engines. The plant was located in a complex that also included two smaller plants, Chevy 9, which made bearings, and Chevy 6, which made fenders, running boards, and splash guards. Although the company was unable to completely assemble cars because of the Fisher strikes, it was operating the three Chevrolet plants to stockpile parts, pending settlement of the strike.

Convinced that a direct assault on the heavily guarded Chevy 4 plant would produce unacceptably high casualties, the UAW devised a ruse to take control peacefully. Aware that the union was infested with company informers, UAW leaders prepared a plan to strike Chevy 9. Sure enough, the company got wind and moved all of its guards to Chevy 9. When the decoy "strike" began in Chevy 9, the guards immediately moved in and forcibly prevented the workers from sitting down. Meanwhile, the UAW had told a handful of workers that its real intention was to seize Chevy 6. When the decoy "strike" started there, company guards rushed over from Chevy 9. Meanwhile, with company guards diverted to Chevy 9 and then Chevy 6, workers seized control of Chevy 4 without a fight.

Following the seizure of Chevy 4 and a second court injunction on February 2, Governor Murphy faced a critical choice, one that would determine the outcome of the strike: enforce the injunction by sending the National Guard into the plants or defy the injunction. He chose to defy the injunction. Troops were stationed around the plants, but did not enter them. Murphy's decision broke the stalemate. General Motors negotiated with the UAW and signed an agreement on February 11, 1937 (Fig. 5.2).

Perhaps GM would have come to the bargaining table without Murphy. The loss of two months' sales was hurting the company, and settling the strike with bloodshed would have severely damaged its image. Privately, top GM officials, like Governor Murphy, felt they could not in good conscience give an order that would cause bloodshed. To save face, GM President Knudsen wrote Murphy that the company had agreed to negotiate with the union because the president of the United States had ordered it to do so. Having decided to negotiate with the union, GM turned to extracting the best possible deal. GM recognized UAW as exclusive bargaining agent for six months in seventeen plants then on strike. All strikers would be rehired at a 5¢ per hour wage increase, and all injunctions and contempt proceedings would be withdrawn. Workers could discuss joining the union with each other during the lunch period without suffering discrimination.

Other car makers, including Chrysler, Hudson, Packard, and Studebaker, recognized the UAW as the collecting bargaining agent through

5.2. Last day of Flint sit-down strike, February 11, 1937: striking workers declare victory when General Motors signs the first agreement recognizing the United Auto Workers union as the bargaining agent. (Kettering/GMI Alumni Foundation Collection of Industrial History)

1937. Several large parts makers also reached an agreement with the union, including Bohn Aluminum, Briggs, Motor Products, Murray, Timken-Detroit Axle, and L. A. Young Spring & Wire.

Ford Organizing Problems

Flush with rapid success at GM, Chrysler, and other firms during 1937, the UAW turned to its most important piece of unfinished business, organizing the Ford Motor Company. Ford presented a unique challenge to the union. As the world's largest industrial complex, with nearly 100,000 workers at one location, Ford the company was a logistical nightmare for organizers, and Ford the man symbolized not only mass production and vertical integration, but also the $5 day and spotlessly clean working conditions. But by 1937 Harry Bennett was running Ford with terror and brutality, and the old man was flirting with Hitler.

The opening shot in the union's organizing campaign was the Battle of the Overpass on May 26, 1937, when Ford Service Department guards severely beat several UAW organizers, including the union's future president Walter Reuther and J. J. Kennedy, who died four months later from the injuries. Serious organizing efforts at Ford were put off for three years.

The Battle of the Overpass gained national notoriety, because at the time of the attack the organizers were posing for newspaper and magazine photographers on an overpass above Miller Road, near the main gate to the Rouge plant. Ford guards confiscated most of the photographers' film, but *Time* printed a series of photographs documenting the brutal beatings, and the *Detroit News* photographer who took the pictures won a Pulitzer Prize (Fig. 5.3).

Meanwhile, the union won several NLRB rulings that Ford had engaged in unfair labor practices under the Wagner Act. The NLRB in December 1937 concluded that from the Battle of the Overpass, "two facts stand out: the unconcealed hostility with which the Ford Motor Company views bona fide labor organizations and the utter ruthlessness with which it has fought the organization of its employees by the UAW."[55]

When Bennett fired several union activists on April 1, 1941, a strike spread swiftly through the Rouge, and by the end of the day all production had stopped. A number of African Americans remained in the Rouge, torn between loyalty to Henry Ford and to the union. Once they decided to join the strike, Henry Ford agreed to hold an NLRB-supervised election on May 21, 1941.

Henry Ford believed that the workers would vote against a union, so when 70 percent voted for the CIO-affiliated UAW, he was crushed and depressed. The company and union quickly negotiated a contract, in which

(Opposite page)

5.3. The Battle of the Overpass, Ford Motor Company River Rouge plant, May 26, 1937: (top) Four UAW union organizers (from left to right, Robert Kanter, Walter Reuther, Richard Frankensteen, and J. J. Kennedy) were posing for photographs on the bridge over Miller Road connecting Gate 4 with the parking lot, when thirty-five Ford Service Department thugs approached them and (bottom) severely beat Frankensteen and the other organizers in full view of newspaper photographers, including *Detroit News* photographer Scotty Kilpatrick, who won a Pulitzer Prize for the series. (From the collections of Henry Ford Museum & Greenfield Village)

FORD MOTOR COMPANY

Ford gave the union essentially everything it had requested. From being the most anti-union car maker, Ford suddenly became the most generous. The company agreed to a closed shop, in which all employees were required to join the union. UAW dues were collected by the company through a check-off on wages. The Service Department was disbanded, and newly hired guards were required to clearly display badges. Ford cars would carry a union label. Ford's relations with the UAW remained the best in the industry through the rest of the twentieth century.

6 . . . To Reskilling Labor

Too often people [in U.S. plants] are seen as the problem and technology is seen as the solution. . . . Japanese managers attribute their high quality and efficiency more to smart workers than to sophisticated technology.
—Robert R. Rehder

American auto workers in the late twentieth century were angry. They were angry with Japanese companies for "invading" the United States. They were angry with the Japanese government for "preventing" U.S. companies from competing there. They were angry with the U.S. government for allowing the Japanese to "invade" without a fight. They were angry with the American public for "unpatriotically" buying Japanese cars. They were angry with their own union leaders for failing to stop the loss of jobs and privileges, as UAW membership dropped in half in twenty years. Most of all they were angry with Chrysler, Ford, and General Motors for failing to meet the Japanese challenge.

Working in the U.S. auto industry in the years after World War II was based on a "deal": an honest day's pay for an honest day's toil. The Fordist production system demanded a monotonous, mindless repetition of a never-changing task in a hot, dirty, noisy factory. But the pay was good, thanks to the collective bargaining agreements between the UAW and the companies.

Most Americans reacted to the collapse of the "deal" as a plague on both houses. Americans had no sympathy for a union protecting auto workers, who were widely viewed as lazy, overpaid, and lacking a work ethic. But the companies' position gained no sympathy either from Americans driving around in shoddily made cars.

U.S. car makers offered a new "deal": in exchange for having their skills genuinely valued by management, workers could exercise more control over their day-to-day workplace tasks. If managers agreed to turn over

more responsibility, workers would agree to accept more flexible assignments.

Many auto workers saw the "deal" instead as a ruse for cutting jobs and a smokescreen for transferring unskilled jobs to plants in Mexico or to independent suppliers. Workers' anger culminated in a 1998 strike against General Motors that proved to be the costliest in the history of the U.S. auto industry. But some found the new deal compelling, or at least worth considering. For example, some workers were impressed that when a 1997 strike at one of its largest parts suppliers crippled its production, Ford sided with the union against the supplier.

The Labor-Management "Deal" Breaks Down

The UAW took advantage of the oligopolistic structure of the U.S. motor vehicle industry during the quarter-century from the end of World War II until the energy crisis in the 1970s to gain attractive wage and benefit packages. The Big Three broke the "deal" in the 1970s, arguing that its foundation—steady, predictable 5 percent–10 percent rates of return on investment—no longer existed. Plants were closed, and workers were laid off permanently. Unions were accused of fighting genuine reforms that would make the U.S. companies more productive and thereby protect jobs in the long run. For its part, the UAW charged the Big Three with making the workers the scapegoats, when the real problems lay in the inefficient, top-heavy management structure, filled with executives who were unable to create and implement new strategies.

The UAW's Pattern Bargaining

The quarter-century of prosperity secured by the United Auto Workers union for its members came through pattern bargaining. Under pattern bargaining, the union opened separate preliminary negotiations with each of the Big Three car makers, and a few days before the contracts were due to expire, it selected one of the companies to concentrate further negotiations. After the union and that company reached an agreement, the same contract was taken to the other two car makers for their approval. If an agreement was not reached, the union struck only that company, while the other two companies continued to operate at full capacity. The targeted company was pressured to settle the strike quickly, because customers were buying cars from the other two companies.

Instead of annual contracts, the UAW agreed to sign multiyear contracts

so that the companies could plan investment and product development over several years free from the uncertainty of possible work stoppages. Contracts ranged from two to five years during the late 1940s and early 1950s, and each company had different starting and ending dates. The UAW and the Big Three signed variable-length contracts in the early 1950s so that all three expired on the same date in September 1955, and three-year contracts became the norm until the 1990s.

The UAW's strike target would be the company considered that year most likely to concede the union's principal demand, or at least most vulnerable to a strike for competitive reasons. In general, the UAW targeted Ford when it was looking for innovative concepts and General Motors (nicknamed "Generous Motors" in those days) when it sought more money. The UAW selected Chrysler when the company balked at proposals already accepted by its two larger competitors.

Walter Reuther, president of the UAW between 1948 and 1970, made the deal for the union. Reuther had a clear vision of the role of labor unions in a democratic, Fordist economic system, and he was able to express that vision effectively. The UAW under Reuther had two main missions: improved wages, security, and working conditions for its members, and greater social justice and economic equality in the United States. Especially significant was Reuther's belief that the two missions were interrelated; progress toward achieving one required progress toward the other. For several decades the vision brought unprecedented well-being to the American auto worker, and also unprecedented prosperity for U.S. automotive manufacturers and the country's middle class.

To achieve the first mission, Reuther adopted a straightforward negotiating principle. In exchange for performing the mindless, repetitive, physically exhausting work on the Fordist production line, auto workers were entitled to two sets of benefits: first, a fair share of the industry's rising profits, through health insurance and retirement pensions, as well as wages; second, protection from the hardships of short-term unemployment resulting from retooling for model changes or cyclical declines in sales.

The union obtained a fair share of the industry's rising profits through a variety of programs. Hourly wages were adjusted according to annual improvement factor (AIF) and cost of living adjustment (COLA). AIF was based on the percentage by which productivity—as measured by output per worker-hour—increased in U.S. industry as a whole. COLA raised or lowered wages in accordance with national price changes, as measured by

the cost of living index. Automotive workers' hourly wages (excluding fringe benefits) increased from $1.50 to $10.77 between 1948 and 1980. Of the $9.27 increase, $5.44 came from COLA and $2.71 from AIF, and only $1.12 through other negotiated contractual increases.[1] The union also negotiated full health insurance not only for current workers, but for retirees and family members as well.

The second type of benefit, security from the cycle of hiring and layoff, was achieved through negotiating supplemental unemployment benefits (SUB), beginning in 1955. Beginning in 1967, SUB provided laid-off auto workers with 95 percent of net take-home pay for fifty-two weeks.

Beyond negotiating higher wages and fringe benefits for its members, the UAW under Reuther articulated a second, broader mission as an advocate of social justice. The UAW played major roles in the two most compelling social justice issues in the United States during the 1950s and 1960s—civil rights and communism. The union supplied money and volunteers for civil rights marches, and Reuther spoke at the 1963 March on Washington, when Rev. Martin Luther King delivered his famous "I have a dream" speech. Reuther removed communist sympathizers from the union and condemned Soviet aggression in Eastern Europe, but he also opposed Sen. Joseph McCarthy's blacklisting and anticommunist witch hunts during the 1950s and was one of the first leaders to speak against the Vietnam War. The UAW was a major supporter and financial backer of Americans for Democratic Action, the Peace Corps, and the Polish Solidarity movement. The UAW withdrew from the AFL-CIO between 1968 and 1981, primarily because of disagreement with the national organization's lack of support for the civil rights and antiwar movements.

Reuther died on May 9, 1970, along with his wife May, in a plane crash at the Pellston airport in the northernmost tip of Michigan's lower peninsula. They were trying to reach a lodge at nearby Black Lake that the UAW had bought as a Family Education Center. At the time of his death, Reuther was probably the most admired labor leader in the country. In many ways, the center is his most tangible monument. UAW members and their families make the long trek up to Black Lake to take courses and fitness programs in austere, unadorned, well-crafted buildings. The Reuthers themselves are buried in the woods overlooking the complex.

When Reuther died, he was succeeded by men of his generation. Like Reuther, the new leaders had worked in the factories as younger men and had participated in the sit-down strikes and other original organizing efforts during the 1930s. These leaders knew that the changes taking place in

the motor vehicle industry during the 1970s were genuine and profound. And the automotive company executives sitting across the bargaining table in the 1970s were not thugs and hoodlums, as many had been back in the 1930s. True, the union and the companies had sharp differences, but in the 1970s discussions and negotiations were more likely than strikes and confrontation to produce mutually acceptable progress. Reuther's successors were unprepared for the collapse of the "deal" forged a generation earlier.

Nearly three decades of negotiating ever more favorable contracts came to end in 1979. Faced with the prospect of Chrysler going bankrupt, the UAW offered concessions and in exchange placed its president on the company's board of directors, a precursor to the arrangement that the UAW would have two decades later after Chrysler was bought by Daimler-Benz. The UAW made wage concessions to GM and Ford in 1982 in exchange for job and income guarantees and profit sharing.

Concessions could not stem the loss of UAW jobs in the United States during the 1980s and 1990s. After reaching a peak of 1.5 million in 1979, UAW membership declined to 1.2 million in 1983, 1 million in 1986, and 800,000 in 2000. The 700,000 union jobs lost just about matched the number of auto industry jobs added in Mexico during the same two decades.

Angered by what they saw as the inaction of their leaders during the late 1980s, dissident UAW members created an organization called New Directions. New Directions leader Don Douglas was elected president of Local 594 in GM's Pontiac plant. Another New Directions leader, Jerry Tucker, a St. Louis auto worker, was elected director of Region 5, which covered plants in eight southwestern states, then was elected one of twenty-two members of the UAW's national executive board. Several officers sympathetic to New Directions were elected at the Mazda plant in Flat Rock. New Directions convinced workers to reject a union-management agreement to implement more flexible work rules at GM's Van Nuys, California, assembly plant. Another dissident group called the People's Caucus won two of seven seats on the local governing board at the New United Motor Manufacturing, Inc. (NUMMI) assembly plant jointly operated by GM and Toyota in Fremont, California, after criticizing union leaders for being too close to management.

Stung by the charges of inaction, a new generation of UAW leaders emerged during the 1990s, committed to a combination of cooperation and confrontation. At Ford, the union enjoyed a cooperative working relationship based on mutual self-interest. At GM, the union-management

confrontations became more forceful. New Directions remained active, but marginalized.

Confrontation at GM

Holding nearly half the U.S. car market, General Motors enjoyed a net income of around $1 billion per year during the 1950s and 1960s, and shared some of that $1 billion a year with the work force. But while "Generous Motors" and the union could share the wealth, they never trusted each other to spend the money wisely.

Writing in 1998, an industry observer noted that "GM factories are generally the least efficient in the industry, partly because labor and management so deeply distrust each other. . . . In private, the two sides seldom have had anything good to say about each other." GM officials accused the union of "dogmatically defending even the most outdated practices." Union officials accused GM of "repeatedly breaking promises to protect jobs and invest more money in new equipment."[2]

Because of the longstanding distrust between GM management and UAW leadership, GM had more difficulty than the other manufacturers adjusting to lean production during the 1970s and then to optimum lean production during 1990s. GM determined that its long-term interest was to confront the union and blame the company's problems on the union's opposition to change.

GM's union-management problems during the 1970s were called Lordstown Blues, after a GM assembly plant in northeastern Ohio. During the 1990s the company's problems were centered in Flint—not by coincidence birthplace of both GM and the UAW.

Lordstown Blues. In 1971, five years after it opened, Lordstown was designated the sole assembly plant for GM's new subcompact, the Vega. The plant was supposed to be GM's largest and most efficient, and the car was supposed to be GM's weapon against the imports. Neither the plant nor the car achieved its purpose. Instead, "Lordstown Blues" became a term widely applied in the automotive industry to describe alienated workers building crummy cars under the supervision of incompetent managers.

The Vega never competed effectively with imports because of poor quality: an easily ruptured muffler, an accelerator prone to jamming in an open position, rear wheels that were liable to drop off because the rear axle was too short. The car's principal virtue was that it could be shipped vertically in a railroad boxcar, thus saving space.[3]

The Lordstown plant never performed to expectations because of provocative management practices and extreme worker reaction. GM concluded that it could not make money building small cars like the Vega, so to minimize losses the company's toughest managers were sent to Lordstown with orders to squeeze production costs as much as possible. Lordstown's managers increased the speed of the assembly line from the typical 60 vehicles per hour to 101. Several hundred line jobs considered too easy were eliminated. Workers were placed on mandatory overtime, sometimes with six or seven 11-hour days per week. When workers filed grievances and started wildcat strikes, managers issued disciplinary warnings and fired militants. UAW Local 1112 struck the Lordstown plant for twenty-two days in 1972. "Most of [the workers] had been in Vietnam, fought and came back with the attitude, who is this punk foreman."[4]

Workers at Lordstown retreated into substance abuse. Younger workers took drugs, which could be bought on the street corner outside the plant. Older workers preferred alcohol, which could be bought on the shop floor or consumed at nearby bars during lunch time. Americans learned not to buy cars built on Mondays or Fridays (when absenteeism was highest after payday on Thursday). Workers at adjacent stations along the assembly line would "double up": one person would do both jobs while the other read, drank, or slept. As long as production quotas were met, top managers rarely ventured onto the shop floor, and foremen were just as likely as the rank and file to have a substance problem.

Gradually Lordstown settled down. GM replaced Vega with somewhat more competitive models, the Monza for the 1978 model year and the Cavalier three years later. As workers aged, they became less militant and more concerned with job security and pension. The local union agreed to a cooperative program with management that included experiments with a four-day work week and Japanese-style teams. Absenteeism at Lordstown went from one of the highest in the GM system to one of the lowest. Formal grievances, which had reached 16,000 before the strike, dwindled to a few hundred.

In the 1990s Lordstown's middle-aged workers were shocked to hear rumors that the plant might close. GM never could figure out how to make money building small cars in traditionally organized U.S. assembly plants. According to GM's so-called Yellowstone Plan, small cars for the U.S. market could be built profitably in newly designed modular assembly plants, such as those in Brazil. As long as an entirely new plant would be needed for small cars, why not locate it in the South or even Mexico?[5]

Anger in Flint. "Buick City" was the name attached during the 1980s, after extensive modernization, to a cluster of a dozen GM buildings on the north side of Flint, some dating from Buick's founding in 1903. In exchange for GM investing in Buick City during the 1980s, the plant's local union agreed to Japanese-style flexible work rules.

A decade after modernization, GM closed Buick City, claiming it no longer needed the plant to build large cars, because plants built during the 1980s in Orion and Hamtramck, Michigan, were more modern and efficient. Evidence from Harbour & Associates and J. D. Power did not agree. After a shaky start, the plant had achieved average productivity and above-average quality, according to Harbour. Power judged Buick City the best assembly plant in North America and second-best in the world in 1989, one point behind Nissan's plant in Oppama, Japan.[6]

The real reason for closing Buick City was conflict with the local union. Buick City's Local 599—with 15,500 members, the UAW's largest local—never formally adopted a modern working agreement. Dominated by supporters of New Directions, the local union accused GM of not spending money that had been promised for plant modernization. The company accused the union of not implementing agreed-upon work-rule changes. GM promised to spend $250 million for a flexible body shop in 1995, an essential improvement to permit the plant to assemble a variety of different-sized models. Two hundred skilled-trades members of Local 599 organized a ninety-minute "job action" to request construction assignments for the body shop project. Rather than meet the demands, GM canceled the project in 1996, effectively sealing the fate of Buick City as an assembly plant.

Job cutbacks hit hard throughout GM's hometown of Flint, not just at Buick City. Employment at GM's Flint plants declined from 77,000 in 1978 to 27,000 in 2000. The first wave of 20,000 job losses in Flint during the late 1980s was the subject of a popular film, *Roger and Me,* written, produced, and directed by Michael Moore, a former auto worker who worked for several alternative newspapers before turning to filmmaking. The film's plot and title came from Moore's many failed attempts to meet with GM chairman Roger Smith to discuss the plant closures and the city's future. Along the way, Moore encountered Flint's desperate and glamorous. Moore could have made a devastating film about the miscalculations and bumbling of GM's leadership. Following Ross Perot for a week would have given him all the ammunition he needed. But that would not have made as entertaining a film.

Rather than incompetent, Flint's leaders were portrayed as callous and

cruel in Moore's film. Wives of executives were interviewed while playing the country club golf course. Wealthy couples dressed as "criminals" spent a night in the new jail for charity. Miss Michigan (soon to be crowned Miss America) was asked about unemployment while riding in a parade. Prayers were solicited from Flint native entertainer, orange juice industry spokesperson, and Right-to-Life advocate Anita Bryant. Offensive ethnic slurs were elicited from another Flint native, Bob Eubanks, host of television's *Dating Game*. The visibly effeminate local theater director urged unemployed automotive workers to attend plays.

The film showed money being poured into ill-conceived projects in downtown Flint to produce minimum-wage service jobs (presumably instead of preserving high-paying factory jobs). Failed efforts at revitalizing downtown Flint shown in the film included a luxury hotel and an entertainment center (both since closed), and a barely functioning retail marketplace.

Meanwhile, the people allegedly most directly hurt by the GM closures—the 20,000 auto workers who lost their jobs in Flint in the 1980s—made only brief appearances in the film. Few of them were in a position to advance the film's perspective, because most had either retired with very generous pensions or been transferred to another GM plant elsewhere in the country. Instead of unemployed auto workers, Moore filmed downtrodden people with no connection to GM being evicted from their homes.

Moore's mean-spirited film may not have accurately explained the impact of GM's closures on Flint, but as a personal statement it did reflect the outrage of current and former automotive workers. GM eliminated far more jobs in Flint after *Roger and Me* was filmed than before, but workers' anger during the 1980s had turned to resignation and indifference by the 1990s. Not even the announcement of Buick City's closure stirred Flint's workers to action.

The confrontation in Flint between the union and GM came to a climax in 1998, not at Buick City, but with a strike by 3,400 workers of UAW Local 659 at the Flint Metal Center. The union claimed that GM had promised to spend $300 million to modernize the stamping facility but had actually spent only $120 million. The company claimed that the union had promised to modernize work rules as a condition of the investment but had not actually implemented the new rules. Anticipating a strike, GM transferred dies for a popular sport utility vehicle from Flint to another stamping plant in Mansfield, Ohio, over the Memorial Day weekend. This action by GM triggered the actual strike.

GM said it had stopped investing in the Flint plant because the union had refused to change work rules that made the plant uncompetitive. In particular, 600 of the plant's 3,200 workers were paid according to "pegged rates," a form of piecework once common but now rare. For example, workers making cradles that support engines in trucks and larger cars were required to complete a specified number. The most proficient could complete the work in less than five hours. For the workers to make more than their specified number of cradles, over a full eight-hour day, GM paid $33 million in overtime in 1997, a major portion of the $50 million the company lost operating the Flint plant that year. The union agreed that workers stood around idle. The real reason, claimed the union, was not because of laziness or overstaffing but because of GM's inefficient management and poor product engineering.

A week later, on June 11, 5,800 workers of Local 651 went on strike against GM's Delphi Flint East plant, over a variety of cost-cutting measures and work-rule disputes. The UAW had picked its target carefully: Flint East made spark plugs, oil and air filters, fuel pumps, and instrument clusters for nearly every GM vehicle, so the single strike forced the shutdown of virtually the entire company.

GM and the UAW both escalated the two Flint strikes into a confrontation over longstanding national issues. The company used the Flint strikes to demonstrate that it was serious about cutting costs to become more competitive. GM's labor cost for the parts in an average vehicle was $2,765, compared to $2,322 at Ford and $2,167 at Chrysler, according to a 1998 Harbour study. The union used the strikes to show that it was serious about halting the loss of jobs to overseas and nonunion plants, what Michael Moore had called the company's "America Last" strategy (Fig. 6.1).

The costliest strike ever in the United States ended after fifty days. GM agreed to return the dies to the Flint Metal Center and to make the promised $180 million in improvements. GM also agreed not to sell Flint East or two brake plants in Dayton, Ohio, before 2000, and to give a week's holiday pay to all striking and laid-off workers who missed their week of paid holiday in early July during the strike. The company also dropped a lawsuit and grievance that the union feared losing. GM had called for arbitration, and when the union balked, the company won a federal court order requiring both sides to proceed without delay. After four days of testimony, the union had concluded that the arbitrator, known to be unsympathetic to the union, might issue an adverse precedent-setting decision that could bar the union from raising investment issues in factory-level strikes in the

6.1. Billboard in Pontiac, Michigan, 1980. This was one of a series of billboards paid for jointly by GM and the UAW to encourage consumers to buy U.S.–made cars. (National Automotive History Collection, Detroit Public Library)

future. For its part, the union agreed to a few work-rule changes, notably a 15 percent increase in the number of parts that the welders must make before stopping work. The union also agreed to reduce the work force at Flint East from 5,800 to 5,000.

GM's losses were estimated at $3 billion in lost production, while the striking workers lost $1 billion in missed paychecks. The union learned that a strike by a few alienated workers in Flint could shut down the world's largest auto maker in 1998, as it had done in 1937. But the union failed to stem the loss of jobs from Flint. A year later, Buick City closed. Buick City ended "with a whimper rather than a bang." Said Michael Moore, "People finally woke up and said, 'Oh, GM's leaving.'"[7]

Outsourcing to Nonunion Plants

While targeting for closure plants where workers opposed modern work rules, GM also confronted the union by transferring work to plants in Mexico, beyond the reach of the UAW. Other work was outsourced to independent suppliers, mostly nonunion. With Big Three wage rates one-third higher than those of typical independent suppliers, and twenty times

higher than those of Mexican plants, outsourcing production of low-skilled tasks was an irresistible source of financial savings.

Maquiladoras *in Mexico.* Building plants in Mexico during the 1980s represented a logical extension of a GM strategy to move production out of strongly unionized areas, begun a decade earlier. GM had built or planned fourteen plants in the American South during the 1970s, primarily in rural areas and small towns. Four were built in Mississippi, three in Louisiana, two each in Alabama and Georgia, and one each in Oklahoma, Texas, and Virginia. GM claimed that southern plants were needed to accommodate a projected increase in the U.S. market that did not materialize.

The UAW, however, regarded GM's search for union-free southern locations as a grave threat, and in the 1976 national contract it secured a pledge of neutrality from the company when the union tried to organize the southern plants. But the union won elections at only two of the fourteen southern parts plants during the 1970s, one of which GM promptly closed. During 1979 national contract negotiations the UAW presented evidence that GM managers were not remaining neutral in a union recognition election then under way at the recently opened Oklahoma City assembly plant. Rather than risk a national strike, GM agreed, as part of the 1979 national contract, to recognize the union at all the southern plants.

With even its southern U.S. plants unionized, GM looked farther south, to Mexico, for sites where it could pay lower wages in a union-free environment. GM (which then included Delphi) quickly became Mexico's largest private employer, with 72,000 workers at 50 plants in 2000. Another 100,000 Mexicans were employed at automotive plants owned by Ford and other U.S. parts makers. Most of the plants were strung out along the cities bordering the United States, especially Ciudad Juarez, Matamoros, Mexicali, Nogales, Nuevo Laredo, and Tijuana.

Mexican border plants became known as *maquiladoras.* The term, derived from the Spanish verb *maquilar,* meaning "to take measure or payment for grinding or processing corn," was originally applied to a colonial tax.[8] Under the *maquiladora* laws, Mexico permitted foreign firms to import components duty-free, assemble them in Mexico, and export them back to the United States. Firms did not have to pay duty on the equipment, raw materials, or subassemblies brought into Mexico. The Mexican government permitted foreign investors to own 100 percent of the enterprise, at a time when other businesses still had to be at least 51 percent

Mexican-owned. The government also streamlined to as little as four weeks approval procedures that had taken up to a year in the 1970s.

When the components were shipped back to the United States for final packaging and distribution, Sections 806.3 and 807 of the U.S. Tariff Code required that duty be paid only on the value added during assembly in Mexico, which was principally the cost of labor. In other words, the duty was the difference between the value of the finished product and the sum of the value of the American-made parts. It did not matter whether the Mexican factory was owned by a U.S., Mexican, or other foreign firm, so long as the components imported into Mexico were made in the United States.

Maquiladora plants specialized in work with high labor content that could be done by relatively unskilled workers needing little training and instruction. The minimum wage in Mexico was about $3–$4 a day, depending on the dollar-to-peso exchange rate, but to attract and retain more experienced workers, auto plants typically paid $1–$2 an hour. The largest number of GM/Delphi *maquiladoras* assembled wire harnesses, which required little more than clipping and bundling color-coded wires. The second largest group of *maquiladora* plants produced other electronic components, such as radios, turn signals, and dashboard controls. A third group produced plastic trim and other body parts.

The U.S. Department of Commerce Office of Technology Assessment compared the cost of assembling Ford Escorts in Hermosillo, Mexico, and Wayne, Michigan, in 1992 (Table 6.1). Despite Mexico's lower labor costs,

TABLE 6.1. Cost of Assembling 1992 Ford Escort in United States and Mexico

	United States	Mexico
Labor	$700	$140
Shipping in-bound parts	$7,825	$8,600
Shipping assembled vehicles	$225	$400
Inventory	$20	$40
Total	$8,770	$9,180

the Hermosillo Escorts cost 5 percent more to assemble than the Michigan ones. Labor was more expensive in Michigan, but accounted for only 8 percent of the total assembly cost. Mexican Escorts were more expensive because of much higher transportation costs, both bringing parts to the assembly plant and shipping out assembled vehicles to dealers. Most of the parts were made in the American Midwest and transported by truck or rail across the border to Hermosillo, and most of the assembled vehicles were sold in the United States.[9]

Nonunion U.S. Plants. Workers at parts plants owned by Chrysler, Ford, and General Motors in the United States were represented by the UAW, or in a few cases by another union, but most plants owned by independent suppliers were not unionized. Therefore, car makers' increased reliance on independent suppliers to produce more parts, components, systems, and modules (as described in chapter 4) resulted in loss of union jobs.

At the historic peak of UAW membership in the late 1970s, the Big Three employed about 1 million union members. Another 250,000 workers at independent parts suppliers were union members, representing about one-half of the parts-making work force. The UAW also represented about 250,000 workers in other industries. In 2000 the UAW still represented nearly all hourly workers at the Big Three, but the number had declined to 400,000 after closure of assembly plants and sale of parts-making operations. The UAW still represented about 250,000 workers at independent parts suppliers, but that amounted to only one-third of the parts-making work force, and more than one-half of the unionized parts makers worked at plants once owned by Ford or General Motors. Excluding former Ford and GM plants, union members declined from one-half to one-fifth of the parts-making work force between 1980 and 2000.

Most large suppliers had at least some union representation. Union membership was essentially universal at the two largest suppliers in 2000, Delphi and Visteon, formerly parts-making divisions of GM and Ford, respectively, as well as at suppliers based on one-time Big Three plants, such as American Axle & Manufacturing, Delco Remy, New Venture Gear, Detroit Diesel, and Guide Corporation. Most of the other very large, U.S.-owned suppliers in 2000, such as Dana, Eaton, Johnson Controls, Lear, ArvinMeritor, and TRW, had a mix of unionized and nonunionized plants. Some plants were unionized because these companies had an early history in the once heavily unionized Great Lakes region, or because they had acquired plants from Ford, GM, and other unionized companies. Nonunionized plants were those acquired from nonunion companies or those that

had been constructed in recent decades in rural areas and the South where union membership rates were historically low.

The main reason for the sharp decline in the percentage of unionized suppliers was the rapid growth of foreign-owned suppliers. Most foreign-owned suppliers had little or no union membership. Unionization was especially rare at Japanese-owned suppliers. The largest Canadian supplier, Magna, had recognized the union in a small percentage of its U.S. plants, and only after hard-fought local elections. The largest German-owned suppliers, ThyssenKrupp and Robert Bosch, had some unionization either because the companies had acquired already unionized plants or because the union had won local elections.

After a rapid decline in membership in the early 1980s, the UAW determined that its most effective strategy to prevent further erosion in union membership was to pressure the Big Three car makers rather than to fight thousands of local elections in anti-union, foreign-owned supplier plants and increasingly nonunion, American-owned suppliers. The 1996 national contract prohibited the Big Three from making unilateral outsourcing decisions without union agreement. The UAW would agree to further outsourcing only if the affected work were fully replaced by new work, so that no further union jobs would be lost. The Big Three also agreed not to move work from union to nonunion suppliers.

One beneficiary of the outsourcing agreement was Lear. Engaged in a three-way battle with Johnson Controls and Magna to produce seats and interior modules, Lear secured most of Ford and GM's contracts in large measure because it had a reputation for being more pro-union than Johnson Controls and much more so than Magna, which actively resisted unionization.

The New "Deal" Takes Shape

The Machine That Changed the World promoted the flexible work rules embedded in the Toyota Production System (TPS) as *the* successful model for labor relations in the twenty-first century. The most important feature of TPS was replacement of the labor-management confrontation typical of U.S. automotive plants with a culture of harmony.

As one industry observer noted, "the Japanese value harmony as much as American managers value profits. . . . The Japanese understand that profit is a by-product of a harmonious and congruent socio-technical system, not an end in itself. Culture, while largely hidden, is a powerful uni-

fying force that fills the gap between what is formally decreed and what actually takes place."[10] The culture of factory activity, not automated machinery, gave Toyota its edge in quality and efficiency, concluded the authors of *The Machine That Changed the World.*

Emphasis on People? . . .

The Toyota Production System created a harmonious culture by empowering employees to feel they were key stakeholders in the company's never-ending quest for high quality and perfection. Rather than working as isolated individuals, employees were grouped into teams of four to eight members. The rigid hierarchy of several hundred job classifications found in a mass production plant was replaced by a handful of designations—perhaps one general classification for most workers and a couple of others for technical skills. Leveling policies also reduced the social distance between workers and managers. Managers worked in open cubicles without doors, ate in the same cafeteria, and parked in the same lot. Instead of suits and ties, managers—as well as workers—wore uniforms showing their first names.

Teams were assigned a position along the assembly line and a set of tasks, and were told to work together to perform the necessary operations. Instead of performing just one task, as in factories organized around traditional mass production practices, workers learned a wide variety of tasks, and sorted out responsibility for rotating them among team members. Workers also had responsibility for checking quality, housekeeping, changing tools and dies, maintaining and repairing equipment, filling out forms, and ordering materials. Periodically, team members were paid to meet in quality circles to suggest ways to improve the production process.

Each team was coordinated by a leader rather than a foreman. In addition to performing assembly tasks alongside other team members, the leader handled administrative duties, filled in for absent workers, and helped those having trouble finishing jobs on time. Team leaders were paid a bit more than other team members, perhaps 50¢ a hour. In the absence of the buffers typical of mass production—extra inventory, extra space, extra workers—TPS required remaining team members to cover for sick colleagues and assure a sufficient inventory at their work station.

When a problem arose, the team dealt with it through a collaborative problem-solving process. It has been said that "Japanese transplants were built around people because only their team members could solve their many complex problems."[11] Through consensus, a team identified a prob-

lem, formulated strategies for dealing with it, implemented a solution, and monitored progress. By creating an atmosphere that emphasized consensus, it was possible to head off many potential problems, through more careful design of products, selection of machines, layout of plants, and handling of materials.

Workers were encouraged to look for ways to improve. An individual suggestion could be minor—for example, putting padding on the dollies that brought windshields to the assembly line could save one or two seconds, because workers didn't have to be quite as careful in loading and moving them. By implementing 99 percent of the 94,000 suggestions submitted by employees at its Georgetown, Kentucky, plant, Toyota saved $74 million in 1997 and awarded $3 million in bonuses for the suggestions.

The most visible element of individual worker responsibility under TPS was the andon cord (*andon* is the Japanese word for "quit") placed above every work station (fig. 6.2). Any worker who saw a problem had the "right and obligation" to pull the cord and stop the entire assembly line. Under mass production, only senior managers could stop the line. When the cord was pulled, a chime sounded and a light flashed on an andon board, indicating the location of the stoppage. Team members and other group leaders promptly converged on the location of the stoppage to fix the problem. If the cord was not pulled again within a minute or two, the entire assembly line shut down until the problem was resolved.

The cord was typically pulled for two types of problems: a defect in a part or difficulty finishing work in the allotted time. Workers were taught that when they spotted a defective part, they should devise a fix by systematically addressing why the problem occurred and tracing the problem back to its ultimate cause. Under mass production, workers had been told to keep the line running, so errors were passed down the line and embedded in the vehicles. A large number of defective vehicles would be built before anything was done about a problem, and rectification was time-consuming and costly.

If a team constantly pulled the cord because of lack of time to complete their assigned tasks, some of the work could be shifted to another team, or more workers could be added to the team. Conversely, a team that finished its tasks in less than the allotted time could lose members or have more work assigned, and under the *kaizen,* or constant improvement, principle, workers were expected to constantly refine their practices to save time.

By encouraging individual workers to stop the line to rectify an error, Toyota found that soon the line never stopped, because recurring prob-

6.2. Final-assembly line, Toyota's Georgetown, Kentucky, assembly plant. Above the vehicles is the andon cord, which can be pulled by a worker to stop the line in case of difficulty. (Toyota)

lems had been identified and addressed through adding personnel, fixing a machine, or changing an operation. The secret of success was simple: "It was the way they teamed up to get rid of a problem. There was no adversarial relationship between people. They wanted to fix things."[12]

Under mass production, stopping the line meant trouble because the factory needed to complete a targeted number of products. Mistakes could be fixed in the rework area after the end of the line but before the vehicle reached the quality checker at the shipping dock. Mass producers found it cheaper to rework vehicles than to stop the line and lose precious minutes and output that would have to be made up through expensive overtime. U.S. firms took the lead in developing new software systems to control manufacturing processes, but Toyota and other Japanese firms took the lead in using human capital. Only jobs that required strictly repetitive routines, such as welding frames, were candidates for automation.

Essential to the successful implementation of teams was recruitment of workers able to perform in an unfamiliar work environment. Under mass production, automotive workers had been hired on the basis of casual contacts. A worker's prospects for being hired improved when he showed two things: prior experience in the motor vehicle industry and personal references from others already working in the plant. In contrast, workers hired for Toyota and other lean production plants in the United States had to pass through an elaborate process run by human resources specialists employed by a consultant firm, a state education department, or the automotive company itself. Job applicants were first tested for basic skills in reading, writing, arithmetic, and mechanical dexterity. Those with acceptable basic skills were placed in small groups for a few hours of behavioral assessment. The group might be asked to work together to perform a task, such as assembling a product, or to solve a problem, such as a faulty process. Assessors observed how applicants interacted with other group members and approached problem solving. Applicants who were considered successful team players were interviewed individually to determine if they were trainable, reliable, and willing to try unfamiliar work.

A particular challenge for human resources specialists was to identify a pool of potentially qualified applicants in the rural South where many of the lean production factories were located. In that region, where high-school dropout rates have exceeded 50 percent, testing for basic high-school skills eliminated a large percentage of potential workers.

Human resources staff were expected to keep employees well adjusted and highly motivated, so that they would cooperate with other team members, remain adaptable to new methods, and provide a continuous stream of suggestions for improvement. To deal with workplace issues, human resources specialists had to be familiar with legal requirements set by the Americans with Disabilities Act, the Family Medical Leave Act, and the Occupational Safety and Health Administration.[13]

"You're treated with respect and dignity, your opinion matters," said one worker, happy to leave behind "unions, foremen, and time clocks" for flexible work rules. "Before, someone else made the decisions. Now I make them."[14] Jobs might be more challenging in teams, but they also were more stressful, because a key objective of lean production was to push responsibility far down the organizational ladder. Responsibility meant freedom to control one's work, but it could also raise anxiety about making costly mistakes.

. . . Or Management by Stress?

Flexible work rules have been called "management by stress."[15] Workers in mass production also suffered stress because of mind-numbing repetitive processes, inability to assemble ill-fitting parts, and lack of say in improving their immediate working environment. But mass production workers who finished their work rapidly earned a reward—idle time for sleeping, smoking, reading, or snacking—that was not available to flexible production workers.

Kaizen meant that under flexible production, managers were constantly identifying slack in the system and eliminating pockets of excess workers and inventories. Although workers had responsibility at their immediate work station, senior management ultimately decided how much work each team should get. Tasks were reassigned so that everyone worked as hard as they could at all times, without the "down" time earned through working fast under mass production work rules.

Wary of working with a union to implement flexible work rules, Japanese companies constructed plants in U.S. communities where unions were weak and workers were unlikely to agitate for a union. Thus, instead of locating plants in the traditional heart of the U.S. auto industry—the Great Lakes area between Buffalo and Milwaukee—Japanese companies selected rural communities farther south. Assembly plants were opened by Honda in Marysville, Ohio, in 1982; East Liberty, Ohio, in 1991; and Lincoln, Alabama, in 2000. Mazda and Ford jointly opened a plant, called AutoAlliance International, in Flat Rock, Michigan, in 1987. A Mitsubishi plant (originally a joint venture between Mitsubishi and Chrysler called Diamond-Star after the symbols of the two corporations) opened in Normal, Illinois, in 1988. A Nissan plant opened in Smyrna, Tennessee, in 1983. Subaru and Isuzu opened a joint plant in Lafayette, Indiana, in 1989. Toyota opened a plant in Georgetown, Kentucky, in 1988 and one in Princeton, Indiana, in 1999.

Japanese companies made clear why they preferred nontraditional locations. "You won't get the cooperation necessary to build a quality product with the union," according to the first manager at Nissan's Smyrna plant.[16] Before choosing Normal, Illinois, a Mitsubishi official wrote, "The rule of thumb we have been using in our site selection process is to avoid going right into the heart of any existing heavily automotive industrial region."[17]

When Japanese companies first opened plants in the United States, the UAW made several attempts to organize workers. For a union to be rec-

ognized as the collective bargaining agent for a plant, a majority of the eligible hourly workers must make that choice in a vote supervised by the National Labor Relations Board. Before the NLRB will hold a vote, it must certify that at least 30 percent of the workers have signed cards saying that they would like to have such an election held.

The UAW circulated cards at Honda's Marysville, Ohio, assembly plant in 1986, but withdrew its organizers a year later when it failed to secure the required 30 percent response. A second attempt to organize Honda in 1989 also failed to get enough signatures. At Diamond-Star, however, 70 percent of 872 eligible workers signed cards, and in 1988 the company recognized the union without an election. The UAW then turned its attention to Nissan's plant in Smyrna, Tennessee, in what would prove to be its watershed organizing effort.

Unionized transplants. The sixteen foreign-managed assembly plants in the United States employed 44,000 workers in 1998. Three of the plants, employing 12,700 people in 1998, were represented by the UAW, while the other thirteen did not have a union. The three unionized plants were operated by Mitsubishi (originally Diamond-Star), AutoAlliance, and NUMMI. Not by accident, the three unionized plants all started as joint ventures between a Japanese firm and one of the Big Three U.S. car makers.

The Mitsubishi plant started as a joint venture between Mitsubishi and Chrysler, known as Diamond-Star, in a newly built facility in Normal, Illinois. AutoAlliance was a joint venture between Mazda and Ford, located in a former Ford plant in Flat Rock, Michigan. NUMMI was a joint venture between Toyota and General Motors, which began production in 1985 in a former GM plant in Fremont, California. Given that the UAW represented all other Big Three hourly workers, it successfully demanded that employees at joint venture plants be similarly represented, although the union agreed to adopt flexible work rules.

NUMMI felt compelled to accept the UAW as bargaining agent to gain public support for a highly controversial joint venture between the largest car makers of Japan and the United States. Before the plant opened in 1985, NUMMI and the UAW Local 2244, which had represented the plant under GM management, signed a seventeen-page letter of intent that established an informal framework for collective bargaining. The letter outlined key values, goals, rules, and procedures to be followed. The first page set the tone for the agreement: "[B]oth parties are undertaking this new proposed relationship with full intention of fostering an innovative labor relations

structure, minimizing the traditional adversarial roles and emphasizing mutual trust and good faith." The agreement continued, "[B]oth parties recognize this as essential in order to facilitate the efficient production of a quality automobile at the lowest possible cost to the American consumer while at the same time providing much needed jobs at fair wages and benefits for American workers."[18]

NUMMI and the UAW negotiated a more formal written agreement a year after the plant reopened. In nonlegalistic language, the agreement emphasized resolution of conflicts and grievances through consensus seeking in a nonadversarial environment. The agreement dismantled the traditional shop floor organization in which workers were represented by a union steward and management by a foreman. The UAW agreed to organize workers into teams, with a leader appointed by the company. Jobs would be collapsed into two categories, assemblers and technicians. Wages and benefits were set at rates prevailing in other auto plants represented by the UAW.

Priority in rehiring was given to members of Local 2244 who had been laid off when GM shut the plant in 1982. NUMMI needed only 2,200 workers to assemble 200,000 vehicles a year, whereas GM had employed 4,000 workers to assemble the same number. NUMMI needed only 20 hours to assemble a vehicle, compared to 34 hours under GM management. Eighty percent of the workers hired for NUMMI had previously worked for GM. Before being rehired, workers had to undergo a three-day pre-employment assessment program, in which the UAW played an active role. The assessment combined American-style interviews and role-playing techniques with concern for values, philosophies, and attitudes consistent with the Toyota Production System.

The Fremont plant had gained a reputation for poor productivity and labor relations during the two decades of GM management. It had been forced to shut four times as a result of strikes and sickouts between its 1963 opening and 1982 closure. In the plant's last year under GM management, 20 percent of the workers were absent without an excuse on a typical day, compared to only 2 percent in the first year under NUMMI management (and 9 percent for other GM plants). "Significantly, although the NUMMI executives selected hourly workers almost exclusively from the displaced UAW workforce as agreed in the letter of intent, the overwhelming majority of the salaried staff were chosen from other sources."[19] "NUMMI chose not to hire back virtually any of the previous GM managers from Fremont."[20] When other GM managers visited NUMMI shortly after the

plant opened, their initial reaction was disbelief in what they saw. Secret repair areas and secret inventories had to exist behind the plant, they told representatives of the International Motor Vehicle Program, because they hadn't seen enough of either for a "real" assembly plant.

Trust in flexible work rules deepened the first time that NUMMI hit a sales slump. Daily production was reduced from 910 to 650 vehicles in 1988, but instead of imposing layoffs, NUMMI took 100 workers at a time from the slowed line and sent them—at full pay—to a training program in problem solving and interpersonal relations.[21]

UAW Fails at Nissan. In 1988, when more than 30 percent of Nissan's workers signed cards, the UAW began an organizing drive at the company's Smyrna, Tennessee, plant. The formal petition was filed in May 1989 with the NLRB, which set an election for July 1989.

At the time of the UAW organizing drive, the average base hourly wage at Nissan was $13.95: 20 percent lower than at Ford, 16 percent lower than at Chrysler and GM, 4 percent lower than at Honda, and 2 percent lower than at Toyota. Nissan's average final annual take-home pay was $32,579: 15 percent lower than at Ford, 9 percent lower than at Chrysler and GM, 3 percent lower than at Honda, but 9 percent higher than at Toyota. Nissan workers fared a bit better on final take-home pay than on base wages because of a relatively generous profit-sharing program during the 1980s; by the 1990s, however, before its sale to Renault, Nissan had few profits to share.

Nissan's fringe benefits were also lower than its competitors at the time of the organizing drive. Annual pension was then 50 percent of average earnings less Social Security—considerably less generous than the $18,000 less Social Security for Big Three employees with thirty years' service at the time, and somewhat less than the pensions at Honda and Toyota. Nissan workers also paid for 12.5 percent of their own health insurance costs through payroll deductions, a greater obligation than the co-payments made by workers at the other companies.

Still, the union could not run a campaign at Nissan on the basis of low pay or poor fringe benefits. Although Nissan paid lower wages and benefits than other car makers, it was far more generous than other employers in rural Tennessee. But the union did have a potent issue at Nissan: with flexible work rules and no union, employees seemed more prone to injury and forced to work while injured or risk losing their jobs. Accordingly, during the election campaign the union featured workers who had been in-

jured on the job at Nissan. Allan "Buddy" Shonting, an installer of sun visors and wiring, had had surgery three times for carpal tunnel syndrome, a hand disorder caused by repetitive motion and torn ligaments. Shonting charged that his injuries resulted from inadequate safety precautions at the plant. After injuring his back, trim and chassis worker Richard Davidson was let go by the company rather than being reassigned to a less physically demanding job.

The Tennessee Occupational Safety and Health Administration required companies like Nissan to maintain a record, known as the OSHA-200 log, which detailed all work-related injuries, where they occurred in the plant, and how they were sustained. The union demanded that Nissan release the OSHA-200 log, and when Nissan refused, the union charged that the company was hiding a poor safety record. After an attorney for four employees complained to the Tennessee Department of Labor that Nissan had refused their requests to see the OSHA-200 injury log, the company was ordered to show the records to all current and past employees. Nissan refused to comply and was fined $5,000 by the state Department of Labor.

Nissan claimed that its injury rate was 8.9 cases per 100 workers in 1987, and that it lost 3.8 days per 100 workers in 1987 and 6.3 per 100 workers in 1988 because of injury. The U.S. auto industry as a whole had higher rates: 25.8 cases of injury per 100 workers and 10.6 days per 100 workers lost because of injury, according to the National Safety Council. The UAW challenged Nissan's figures, because in Tennessee only injuries resulting in eight or more lost work days had to be reported. Counting injuries resulting in seven or fewer lost days pushed Nissan's rate to around 20 days per 100 workers, twice the national average, according to UAW assistant director of health and safety, Dr. Michael Silverstein. The UAW also pointed out that Nissan had been cited twice by state inspectors for minor safety violations resulting from excessive line speed.

The union also challenged Nissan's policy of hiring nonunion outside contractors, Ballinger Industrial and Commercial Services (BICS) and Fluor Daniel, to provide maintenance and support services, including janitorial work, waste treatment, utility maintenance, grounds upkeep, and warehousing. The union argued that Nissan workers disabled during assembly line work should be reassigned to these less physically demanding support jobs.

The company vigorously contested the union vote. Strongly anti-union presentations were frequently broadcast on the plant's closed-circuit tele-

vision system. Anti-union employees were made available for press interviews. Nissan managers led anti-union meetings with small groups of workers who had not publicly revealed their positions.

In the event, the union lost badly: 1,622 votes against the union, 711 in favor, and 50 not voting. Pro-union sentiment had stalled at the 30 percent level that the UAW initially secured to petition for the vote. "The bottom line here is that the union failed to find an issue that our employees are unhappy about," claimed Nissan president Jerry Benefield. "There must be a good reason for employees to want to pay $30 a month in dues to the UAW."[22]

One month after the election, Nissan fired Buddy Shonting, alleging that he had falsified his employment records by hiding a 1983 worker's compensation claim against a previous employer. Nissan said that the dismissal was unrelated to Shonting's leadership role in the failed unionization campaign. Shonting appealed the dismissal before a committee of three plant supervisors but was turned down, and a committee of three peers and two supervisors then voted 3–2 not to reinstate him.

After the failure at Nissan, the UAW was unable to mount a serious organizing drive at any other Japanese-owned plants. Another effort at Nissan was ended soon after it started in 1997. At Honda plants in Ohio, a Teamsters local from nearby Columbus launched an unsuccessful effort in 1999 to secure enough signatures for an election.

Japanese-managed plants in the United States implemented the team concept during the 1980s with young, freshly hired workers who had not experienced the rigid seniority system of a U.S.–owned unionized plant. By 2000 many of the Japanese plant employees had been working for fifteen years and were over age forty. At a traditionally organized unionized plant, older workers would have enough seniority to claim "easier," less physically challenging jobs as a reward for having performed the most painful, unpleasant jobs as new hires. But the *kaizen* concept in Japanese-managed plants didn't provide "easy" jobs for older workers. With only a handful of job classifications, the lack of a steep career ladder could prove disappointing and disconcerting to workers. For this reason, unionization of foreign-owned plants in the United States would be inevitable, according to labor relations analyst Harley Shaiken. "As soon as the work force ages, as growth slows down, and as the Japanese try to cut corners in this competitive industry, this may lead to workers wanting representation." But management consultant Jim Harbour disagreed: "The more they stay without the union, the stronger they get."[23]

Ford Cooperates with the Union

In 1946, a few months after succeeding his grandfather as president of the Ford Motor Company, Henry Ford II gave a speech at the annual meeting of the Society of Automotive Engineers, outlining his views on labor unions. "We of the Ford Motor Company have no desire to 'break the unions.' . . . We want to strengthen their leadership by urging and helping them to assume the responsibilities they must assume if the public interest is to be served." As head of the company that had revolutionized mass production, Ford pledged to give "the same hard-headed attention to human factors that we have given so successfully in the past to mechanical factors." He concluded, "There is no reason why a union contract could not be written and agreed upon with the same efficiency and good temper that marks the negotiation of a commercial contract between two companies."[24]

After violent confrontations during the Depression and enforced austerity during World War II, workers felt entitled to higher wages and benefits, and companies felt entitled to labor peace so they could rebuild their shattered businesses. If workers were willing to fight for their union during the 1930s, and for their country during the 1940s, they were willing to fight in the postwar years for their fair share of the profits. If companies were able to survive the Depression to become the arsenal of democracy during the war, they were willing to fight for responsible negotiations and an end to unauthorized work stoppages.

Ford's 1946 speech changed the entire atmosphere of labor relations at the Ford Motor Company. While GM was in the midst of a 113-day strike, Ford peacefully negotiated a new contract with the UAW. Through the remaining decades of the century work stoppages at Ford were rare. Ford headed into the twenty-first century with an important advantage: a labor relations model suited to optimal lean production that combined elements of Japanese-inspired lean production with traditional elements of mass production–inspired collective bargaining. According to Ford Motor Company officials, "Ford views its cordial relations with the union as a competitive advantage."[25]

As a result of its longstanding "cordial relations," Ford could ask for help from the union when it was in trouble during the 1980s—and get it. Needing to cut costs and restructure operations in the face of Japanese competition, Ford did not confront the union with demands for concessions. Instead, the union and the company worked together in the early

1980s to understand lean production. Managers tried hard to give workers a greater role in restructuring and, more important, a greater sense of participation in the decision making. Confident in the fairness and decency of managers, Ford workers accepted that the best way to protect their jobs was to work together.

Instead of imposing Japanese-style teams at the same time on everyone, plant managers and union officials organized teams where it seemed logical and natural to do so. Rather than rewrite the collective bargaining agreement, management and union officials of individual plants worked out informal programs on the shop floor for teams of employees to learn each other's jobs and reorganize specific production functions. Groups of workers were permitted to meet regularly on company time to think up ways of doing things better and more efficiently—if they wished. Vehicle and machinery designers were permitted to pull individual workers off the line and ask them for advice on design problems. The IMVP found in the late 1980s that Ford workers were ignoring their narrow job assignments and informally cooperating in their jobs.

A National Education, Development and Training Center in Dearborn was funded and managed equally by Ford and the UAW. The center ran courses and programs on automotive technology, employee orientation, financial management, skills enhancement, college and university options, and retirement planning. Hourly workers received tuition vouchers in the amount of $2,000 annually to study anything they wished at nearby colleges.

Intensive training programs helped to improve Ford's troubled plants during the 1980s. For example, Ford's Louisville assembly plant, plagued by especially low quality and productivity ratings, was slated for closure in the late 1970s, but a decade later was one of the company's most profitable facilities. Forty employees at a time were taken off the shop floor or out of the office for an eight-day training program. The course covered interpersonal skills, problem solving, and motivation. Because plant quality measures required calculating statistics and displaying them on a chart, an intensive course was designed to overcome employees' discomfort in dealing with statistics.[26]

Quality teams of managers, engineers, and line workers were placed in Ford plants to solve problems. In the so-called quality circles, line workers were empowered to identify problems causing defects and to devise solutions.[27] Ford formed Plant Vehicle Teams in each assembly plant to find and fix vehicle quality problems and reduce costs. The troubleshooting teams

could run consumer clinics and focus groups and use the information to design vehicle engineering changes. In the past, a problem identified in the plant had to be routed through Ford's centralized manufacturing operations, to product development and purchasing, back to manufacturing, and then to the plant. Instead of taking weeks, problem solving through Plant Vehicle Teams could take minutes.[28]

Ford and the UAW built a long-time harmonious relationship through stable leadership. For two decades Ernest Lofton served as the UAW's vice president and director of the Ford Department, and Peter J. Pestillo served as Ford's executive vice president for corporate relations, in charge of labor relations. The two men were known as partners on the golf course as well as in the workplace. GM's chief labor relations official was buried three layers lower in the company's management than was Ford's.

Given their close relationship, the UAW and Ford agreed in 1993 and again in 1996 to negotiate the first pattern-setting national agreement. Ford was able to obtain a contract extending its competitive advantage over GM, with such provisions as lower wages for newly hired workers, at a time when Ford was hiring many more new workers than GM. The UAW cooperated with Ford in closing the Lorain, Ohio, car assembly plant in 1997, and Ford paid 1,000 workers $45,000 each to move to its expanding Louisville plant. For its part, Ford removed factory managers who didn't get along with workers, while GM tended to transfer them to other plants.[29]

Loyalty to Ford among employees was so great that the company's effort to spin off its parts-making operations into Visteon Automotive Systems was thwarted until it agreed to keep 23,500 Visteon workers on the Ford payroll. Although working for Visteon, the former Ford workers would receive Ford checks and Ford pensions. Only new workers hired after the spin-off would be Visteon employees.[30]

As GM suffered through the costliest strike in U.S. history, Ford demonstrated why it had good relations with the union. Two hundred UAW workers went out on strike in 1998 at a Johnson Controls (JCI) plant in Oberlin, Ohio, that made seats for the Ford Econoline van. Another 350 struck Johnson's Plymouth, Michigan, plant that made seats for the Ford Expedition sport utility vehicle. Strikers demanded wages comparable to levels paid at Lear Corporation seat plants represented by the UAW.

Ford itself had nearly suffered a strike by the UAW back in 1995, when it outsourced Econoline seat production to JCI's Oberlin plant, which was then nonunion. After the UAW collected enough cards to hold an election

in 1996, JCI recognized the union at Oberlin, as well as at plants in Strongville, Ohio, and Plymouth, without going through an election. JCI made it clear that it was recognizing the union because it did not want to antagonize Ford, its largest customer. A Ford spokesperson demurred, however, saying: "We don't dictate how suppliers handle their relationship with their employees."[31]

The critical moment in the 1998 JCI strike came when the supplier offered to make seats for Ford at other nonunion plants. Although it was losing sales of two of its most profitable vehicles, Ford refused. Instead, Ford transferred seat production to a plant owned by Lear, which had good relations with the union, and to a Visteon parts plant. Ford's move forced JCI back to the bargaining table, and the strike was settled.

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7 *From a Class-based Market . . .*

[The goal of GM is] to create both consumer satisfaction and consumer desire, and at the same time.

—GM president Alfred P. Sloan, 1923

General motors' vision of what it—and most Americans—wanted from the future was most clearly displayed at the 1939 New York World's Fair. Four million people waited hours in line on switch-back ramps leading into a cleft in the large white façade of a building designed by America's foremost industrial architect, Albert Kahn. Inside the building, visitors sat in one of six hundred upholstered chairs that carried them through the Futurama, designed by Norman Bel Geddes—a sixteen-minute tour above the United States of 1960, as it might be seen from a low-flying airplane.

From a speaker embedded in the chair, viewers heard a confident narrator using the theories of urban planning and the principles of highway engineering to describe the future scene. The narrator told why each scene was important and likely to occur. At one point, viewers "flew" over a highway: "Looming ahead is a 1960 Motorway intersection. By means of ramped loops, cars may make right and left turns at rates of speed up to 50 miles per hour. The turning-off lanes are elevated and depressed. There is no interference from the straight ahead traffic in the higher speed lanes." Near the end of the tour, the scale changed, giving the illusion of moving in closer on a large city. Visitors viewed in more detail a ninety-block area of the city, with seven-lane highways, express boulevards, feeder streets, elevated sidewalks, and "autogyros" landing decks atop skyscrapers. There were few buses, however, and no streetcars, subways, or smog. "On all express city thoroughfares the rights of way have been so routed as to displace outmoded business sections and undesirable slums whenever possible. . . . With fewer people in our central cities, and with the stores

spreading out, property values in the center of town have decreased. . . . This has given us a chance to tear down buildings, widen streets, and turn our 'blighted' areas into more pleasant-looking places by letting in the light."[1]

Visitors had the sense of moving in ever closer on the large city until they were in the midst of a single intersection at full scale. When they got out of their chairs, they found themselves actually walking on an elevated sidewalk of a 1960 city. As they left Futurama, each visitor received a blue-and-white button that said I HAVE SEEN THE FUTURE.

General Motors became the world's largest manufacturer because it understood consumer preferences better than any other corporation, and it shaped and manipulated these preferences successfully for more than a half-century. This chapter examines how GM stimulated demand to replace older vehicles by marketing products that differed cosmetically from one year to the next, and from others offered in the same year. Following the dictum of GM president Alfred P. Sloan, Jr., "a car for every purse and purpose," the company offered a variety of products, each attractive to a different social class.

Consumers in the United States and other rich countries hold onto stoves and washing machines as long as they operate reliably, perhaps for decades, but dispose of perfectly serviceable motor vehicles every few years and replace them with others that perform not much differently. The decision to buy a new vehicle, as well as the selection of the model to purchase, is highly emotional. Figuring out complex consumer motivations and inclinations made GM the world's most successful motor vehicle manufacturer for most of the twentieth century.

The Ford Motor Company sold half of the vehicles in the United States and produced half of the entire world's total during the 1910s because Henry Ford had listened to early customers. He knew intuitively what other industry pioneers did not: that demand for vehicle ownership was universal. Having recognized—and to a considerable extent stimulated—universal demand, Ford tinkered with his factory production system until his company could turn out large batches of identical, low-priced vehicles to satisfy this limitless demand.

Ford Motor Company stumbled badly, however, when it failed to detect changes in consumer attitudes during the 1920s. Its market share slipped from one-half to one-fourth. Ford had sold most American families their first motor vehicle, but General Motors sold them their second, third, and subsequent vehicles.

The mass production system invented by Ford and perfected by GM generated economies of scale that drove smaller competitors out of business. By the 1950s GM had achieved near monopolistic dominance, and together with a revitalized Ford and an upstart Chrysler, it held 95 percent of the U.S. market. With the monopoly—or at least oligopoly—the Big Three no longer had to listen closely to what the customer thought. Instead, they turned out mass-produced vehicles that industry designers found appealing and accountants found profitable.

When the market changed through a combination of internal pressures (the breakup of the old, rigid, class-based market) and external pressures (the 1973–74 energy crisis), U.S. companies were caught off guard. They were slow to realize that consumer preferences had changed fundamentally, slow to design suitable products once they recognized market changes, and slow to build vehicles once they had designed new ones for the changing market. The Big Three ceded to Japanese and European companies a large share of the U.S. market.

A Car for Every Purse

The U.S. automotive industry faced its gravest marketing crisis in 1920. Sales had increased by an average of 45 percent per year through the first two decades of the century, thanks primarily to Ford. The only year that sales declined, 1918, was in the middle of World War I, and vehicle producers hardly suffered, because they made money manufacturing equipment for the war effort. With the end of the war, pent-up demand helped sales quickly rebound in 1919 to prewar levels.

But vehicle sales dropped nearly 20 percent in 1920, and the industry didn't have a world war to blame. Ford's Model T sales dropped from 826,000 in 1919 to 420,000 in 1920. General Motors lost money in 1920 (for the last time until 1993), and its president and founder William C. Durant was forced to resign. The number of vehicles registered in the United States, which had risen nearly 40 percent, or 1 million, per year during the 1910s, increased by only 8 percent, or 500,000, per year during the early 1920s. Gloomy analysts feared that the market for new cars was saturated in the United States, because every family who could afford one already had one.

All but a handful of manufacturers stopped making vehicles during the 1920s and 1930s. The number of U.S. producers declined from 108 in 1920 to 44 in 1929, and when civilian vehicle production was halted three

months after Pearl Harbor, in February 1942, the United States was left with only 8 vehicle producers.[2] Casualties among companies that had once sold at least 1,000 vehicles a year included Anderson, Apperson, Case, Chalmers, Cleveland, Cole Aero, Columbia, Davis, Dort, Earl-Briscoe, Elgin, Gardner, Grant, Haynes, Jackson, Jordan, Kissel, Lexington, Liberty, Locomobile, Maibohm, Maxwell, Mitchell, Moline Plow, Moon, Stearns Knight, Stephens, Velie, Westcott, and Winton. Other vehicle producers, which survived the early 1920s, succumbed a decade later during the Great Depression.

Also in decline was the number of distinct nameplates sold in the United States. According to *Motor Age* magazine, 270 companies produced 400 different nameplates in 1911. In 1915, 119 firms produced 200 models.[3] The number of nameplates on vehicles sold in the United States declined further, from nearly 200 in 1922 to 47 in 1929. Production of 49 nameplates ceased in 1923 alone, and another 36 died in 1924. In 1942 the United States was down to 17 nameplates. GM offered 5 nameplates (Buick, Cadillac, Chevrolet, Oldsmobile, and Pontiac); Chrysler, 4 (Chrysler, DeSoto, Dodge, and Plymouth); Ford, 3 (Ford, Lincoln, and Mercury); and Hudson, Nash, Packard, Studebaker, and Willys-Overland, 1 each.

While the number of manufacturers and nameplates declined rapidly in the United States, the number of registered cars resumed its rapid increase in the mid-1920s, from 10 million in 1923 to 17 million in 1925. After a decade of stagnation during the Great Depression and World War II, when registrations went from 23 million in 1935 to 26 million in 1945, the number of vehicles on U.S. streets continued to grow rapidly, to 52 million in 1955, 107 million in 1975, and 200 million in 1995.[4]

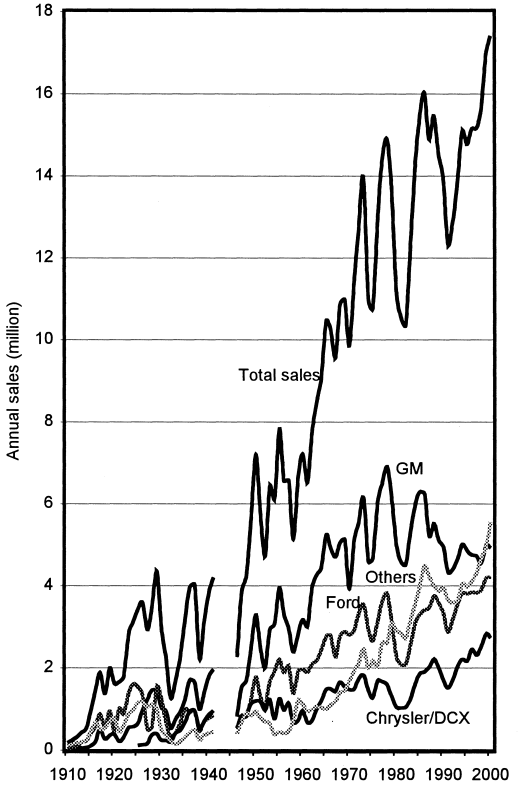
The rapid declines in producers and nameplates, combined with the rapid increase in registrations, meant that surviving firms sold a lot more vehicles. Those survivors were first and foremost General Motors, followed by Chrysler, and then Ford, forming what first became known in the late 1920s as the Big Three.

Just one producer, Ford, held nearly half of the market during the 1910s. In the 1920s two firms—GM and Ford—held about two-thirds of the market, with Ford still holding half at the beginning of the decade, and GM and Ford each claiming one-third of the market at its end. In the 1930s, after most of the smaller companies had gone bankrupt, three companies accounted for 85 percent of the market, with Chrysler joining GM and Ford to form the Big Three.

General Motors held less than 20 percent of the market during the

1910s, but climbed above 40 percent during the 1930s and remained at that lofty level until the 1980s. GM exceeded 50 percent twice during the 1950s, but deliberate policies kept the company's market share below that mark most years. GM's market share dipped below 40 percent only twice between 1931 and 1986, during the Depression year of 1935 and in the first year of production after World War II, 1946 (Fig. 7.1).

Chrysler Motor Corporation, established by Walter Chrysler in 1923, became the third-largest vehicle producer in 1928, passing Hudson, with about 10 percent of the market. Chrysler grew rapidly, first by taking control in 1925 of financially troubled Maxwell-Chalmers Company (Walter Chrysler was also president of that company). Then, three years later, Chrysler acquired Dodge Brothers, which had been sold in 1925 to the Dil-



7.1. U.S. sales by producer, 1910–2000. GM sales in the United States fell from their historic peak during the 1970s, while DCX, Ford, and other firms increased sales. (Compiled by author from multiple sources)

lon, Read & Company bank by the widows of the company's founders John and Horace Dodge, who had both died in 1920.[5] Chrysler's share grew during the 1930s and 1940s to a peak of 24 percent reached in 1937 and again in 1946. Chrysler was the second-largest car maker behind GM when production was halted for World War II, but slipped to a low of 9 percent in 1962. It then settled into the 10–20 percent range during its final four decades of existence, before being acquired by Daimler-Benz in 1998.

Ford had the greatest changes in market share during the first half of the twentieth century. It captured over 40 percent of the market during the 1910s, and hit a peak of 61 percent in 1921. With the end of Model T production in 1927, Ford's market share dropped to 17 percent, rebounded to 41 percent in 1930, declined to 20 percent in the 1940s, and recovered to around 25 percent during the 1950s, where it remained for most of the rest of the century.

The Big Three's market share temporarily declined immediately after World War II, when smaller companies, such as Hudson, Nash, and Studebaker, converted more rapidly from military back to civilian production and quickly introduced new postwar products. Crosley, Kaiser-Frazer, and other new car makers temporarily increased the diversity of nameplates offered in the United States after World War II, but they accounted for a small percentage of sales before disappearing in the 1950s. The Big Three's combined, all-time high market share was 94 percent, reached in 1955, 1956, and 1959.

Altogether, the Big Three maintained their domination for a half-century, accounting for five of every six vehicles sold in the United States from the late 1920s until the late 1970s. Analysts in the 1950s saw inherent business logic in the geometric pattern of GM holding about one-half of the market, Ford about one-fourth, and Chrysler about one-sixth.

The Big Three's decline in market share came quickly—a drop of ten percentage points between 1978 and 1980. The percentage remained relatively constant in the 1980s and most of the 1990s, at a bit under three-fourths of the U.S. market, then declined in the late 1990s and early 2000s to two-thirds of the market. Ford continued to hold about one-fourth of the market, and Chrysler about one-sixth, but GM declined to about one-fourth.

Rationalizing GM's Products

General Motors' future was especially shaky in 1921. Although it trailed only Ford in market share, GM sold less than 200,000 cars and trucks that year—only 12 percent of the market. Worse, the outlook was discouraging:

the number of first-time buyers in the United States seemed to be stabilizing at a bit over 500,000 a year and, if anything, appeared likely to slip. Besides, Ford had secured a lock on first-time buyers by pricing its vehicles much lower than any other company, including GM.

With most first-time buyers still attracted to Ford's low-priced Model T, GM had no choice but to look for consumers considering the replacement of older vehicles with newer ones. Rich people could be counted on to buy the latest, most luxurious, most powerful cars, but those customers amounted to perhaps 20,000 a year, and GM had plenty of competitors for their business. About 500,000 decrepit cars were scrapped in 1921, and the car makers hoped their owners would buy replacements—but even a sizable chunk of that market would not be enough to restore GM to prewar production levels, let alone stimulate growth.

But the pessimists of the early 1920s were wrong. Annual U.S. sales grew from 1.7 million vehicles in 1921 to 4.3 million in 1929. Ford captured one-fifth of that 2.6 million growth, and Chrysler and several small companies gained one-sixth each. But GM got nearly half of the growth, when its sales jumped from 200,000 in 1921 to more than 1.4 million in 1929.

When Ford finally shut down Model T production in 1927, GM surged ahead as sales leader, with more than 40 percent of the U.S. market in 1927 and 1928. GM's market share slipped in 1929 and 1930 a few percentage points behind Ford, which was selling its new Model A. But when vehicle sales plummeted during the Depression, GM captured an increasing share of the declining market. GM held nearly half the market in the worst year of the Depression, 1932, when only 1.3 million vehicles were sold.

While other companies floundered and failed in the 1920s and 1930s, GM figured out how to sell more cars—a lot more. The turnaround started when GM president Pierre du Pont hired engineering consultants in 1921 to independently evaluate the company's eleven models, which were marketed under seven nameplates (Table 7.1). Their conclusions were devastating: quality was poor and pricing was illogical.

Only two of the company's seven nameplates—Buick and Cadillac—had favorable consumer recognition for high quality. Chevrolet, Oakland, and Oldsmobile were selling outmoded prewar designs with such poor reputations among consumers that the consultants recommended changing their names when new models were ready. Scripps-Booth and Sheridan had minimal marketplace recognition.[6]

The consultants had especially harsh words for Chevrolet, supposedly GM's low-priced volume leader, which was outsold by Ford by a ratio of 14

TABLE 7.1. GM Products, 1921

Nameplate	1921 Sales	Actual 1921 Prices		Recommended prices	
		Minimum	Maximum	Minimum	Maximum
Chevrolet	66,769				
490 4 cyl.		$775	$1,375	$450	$600
FB 6 cyl.		$1,320	$2,075	N/A	N/A
Oakland (6 cyl.)	11,852	$1,395	$2,065	$600	$900
Buick	80,122				
4 cyl.		N/A	N/A	$900	$1,200
6 cyl.		$1,795	$3,295	$1,200	$1,700
Oldsmobile	18,584				
4 cyl.		$1,445	$2,145	N/A	N/A
6 cyl.		$1,450	$2,145	N/A	N/A
8 cyl.		$2,100	$3,300	$1,700	$2,500
Scripps-Booth (6 cyl.)		$1,545	$2,245	N/A	N/A
Sheridan (4 cyl.)		$1,685	$1,685	N/A	N/A
Cadillac (8 cyl.)	11,130	$3,790	$5,690	$2,500	$3,500

Source: Sloan, *My Years with General Motors,* p. 59.

to 1 in 1921. Chevrolet suffered from undistinctive styling unchanged since World War I, weak rear axles and driveshaft, and serious engineering flaws. When William Knudsen came over from Ford as vice president of Chevrolet production, he said that the 1923 Chevrolet would be better because of one small change: "We're going to hang a small hammock under the chassis [to] catch all the goddamn parts that fall out."[7]

GM's eleven models overlapped too much in price. Competing against each other to sell $2,000 cars were Scripps-Booths, two Oldsmobile models, the highest priced Chevrolet and Oakland, and the lowest priced Buick. Meanwhile, the lowest price Chevrolet was nearly twice as expensive as Ford's cheapest car. The price structure meant that not only were nameplates competing against each other, the company suffered disproportionately when the market for relatively expensive, $2,000 cars declined. Similarly, in 2000 GM would again have too many overlapping, competing vehicles, now priced around $20,000.

General Motors had too many nameplates because its first president,

William C. Durant, bought every company he could and then granted each of them nearly total autonomy in setting prices. Two weeks after incorporating GM, Durant began a buying binge, believing that diversification minimized risk. In the words of one industry chronicler, "the business of an individual manufacturer was hazardous because the model on which he staked his chances of sales might prove to have some mechanical defect or the body design might fail to strike the fancy of the buying public."[8]

One of Durant's misguided acquisitions was Cartercar, which sold a grand total of 7,172 vehicles between 1910 and 1915. In Durant's words, "They say I shouldn't have bought Cartercar. Well, how was anyone to know that Cartercar wasn't to be the thing? . . . I was for getting every kind of thing in sight, playing safe all along the line."[9] Other unsuccessful cars that Durant bought for GM included Elmore, Ewing, Marquette, Randolph, Scripps-Booth, Sheridan, Welch, and Welch-Detroit. Durant also bought some winners: Chevrolet, Oakland (predecessor of Pontiac), Oldsmobile, Buick, and Cadillac. The next generation of GM executives could rationalize the product line, because Durant had bought so many companies in the first place.

When DuPont took control of GM in 1921, Alfred P. Sloan was placed in charge of an internal committee to implement the consultants' recommendations. Sloan's committee scrapped Scripps-Booth and Sheridan but retained Chevrolet, Oakland, and Oldsmobile, because establishing a new name in the market was expensive. Seventy-five years later, the same argument was used but failed to save Oldsmobile when declining sales caused its elimination. Sloan's committee recommended repositioning the prices of the surviving models to eliminate overlap, as shown in Table 7.1. GM's Executive Committee established stringent rules for the pricing of new models to eliminate internal competition and to cover all segments of the market.[10]

To create the perfect structure, GM spent three decades tinkering—swapping Buick and Oldsmobile in the price table; adding Pontiac and LaSalle (a lower priced Cadillac) in the 1920s; dropping Oakland in 1932 and LaSalle in 1940; adding and then dropping Viking and Marquette as a lower priced Oldsmobile and Buick, respectively, during the 1930s; remolding Pontiac in the 1950s from a stodgy to a high-performance image. But GM's fundamental pricing structure survived into the 1960s.

Under Durant, Sloan recalled, "prices were largely determined by the initiative of the different managers. . . . I remember one executive committee meeting at which one division manager said to another, 'I see you

raised your price $150 the other day.' The other said 'yes,' and the first one said, 'I guess I'll do the same thing tomorrow.'"[11] Sloan instead selected prices to "place [GM] cars at the top of each price range." Although du Pont wanted to compete head on with Ford in the low-priced field, Sloan argued that GM should price Chevrolet a bit higher. Similarly with the other makes, prices were set so that consumers perceived they were paying a bit more for a much higher quality product.

Within a few years, Sloan's strategy had been proved correct. Ford sold most people their first car, but GM—offering more features at somewhat higher prices—sold most people their second car. As one former Ford official stated in 1926: "There are not very many people who buy a second Ford."[12] The same strategy would work well for Toyota a half-century later.

Product Segmentation

Ask almost any American in the 1950s to rattle off the names of GM's five brands of cars, and the response would be Chevrolet, Pontiac, Oldsmobile, Buick, and Cadillac—in that order. Americans did not learn GM's products in alphabetical order, they learned them in price order. And most Americans in the 1950s actually knew the names of GM's five nameplates. Through deliberate engineering and adroit advertising, GM carefully protected the integrity of the price hierarchy it had created in the 1920s.

GM's marketing structure worked because it both reflected and shaped the American class structure. It created a "ladder of consumption," in which a person who owned a Buick was instantly identified as belonging to a higher social class than a person who owned a Chevrolet. In the words of historian Daniel Boorstin, the car became a "visible and easily understood symbol of personal progress."[13]

GM's strategy brilliantly reflected the realities and aspirations of the American family, and corporate advertisements listed the products by price. Chevrolet was the car for the masses; Cadillac, for the aristocrats; and the other three cars, for the growing middle classes in between. A young couple just getting started, without much money and with a baby on the way, bought GM's lowest price Chevrolet for their first new car. As the couple aged—"matured," in the preferred marketing term—the husband was promoted to higher paying, higher status jobs, the wife socialized with women of higher social standing, and the Chevrolet was swapped for a succession of higher status GM cars. Perhaps the couple stepped up to a Pontiac, a bit sportier than a Chevrolet; or to an Oldsmobile, with its allegedly "advanced" engineering features, such as a "Rocket" engine and a Hydra-

matic transmission; or to a Buick, comfortably appointed for a successful doctor or lawyer; or ultimately, to the unrivaled luxury of a Cadillac.

Henry Ford's genius had been to recognize that desire to own an automobile was nearly universal in the United States. As president of General Motors in the 1920s, Alfred P. Sloan understood that although the desire to own an automobile may have been nearly universal, ability to pay for one was not. Ford built one car for the masses, and that was good enough in the 1910s. By the end of the 1920s GM was selling cars to people in every social class, from the humblest factory worker to the loftiest aristocrat.

Chevrolet. A chronological recounting of GM's history would end rather than begin with Chevrolet, as the last of the major nameplates to become part of General Motors. But owning a Chevrolet was the first rung when climbing GM's ladder of success. A succession of advertisements turned Chevrolet ownership into a patriotic duty. Successive generations of GM advertisements encouraged Americans to "see the U.S.A. in your Chevrolet"; to associate "baseball, hot dogs, apple pie, and Chevrolet"; and to equate Chevrolet with "the heartbeat of America" (Fig. 7.2). All this with a name that rhymed with *hay* not *pet,* as most Americans, unfamiliar with foreign languages, would have otherwise mispronounced.

It was Durant's supreme accomplishment to turn Chevrolet, named for a moderately famous Swiss race car driver, into a synonym for the best-selling, entry-level car of all time. Durant, who had hired Louis Chevrolet to race for Buick a decade earlier, provided funds in 1911 to design a relatively large, expensive, powerful, luxury vehicle. Durant's haphazard, probably exaggerated, records claimed sales of 2,999 in 1912, an impressive figure at the time for the first year of production, if true. But the car was "something ponderous rather than whippet-like."[14]

Durant was interested in developing a new car in 1911, because a year earlier he had been forced to relinquish control of General Motors after failing to repay loans he had secured to pay for its rapid growth. After being forced out of GM, Durant established Republic Motors as a holding company for two vehicle producers—Chevrolet and the Little Motor Car Company. Durant also acquired the Mason Motor Company to make Little's engines. The Little car—actually named for former Buick general manager William Little, a friend of Durant—was an underpowered, hastily engineered, "coughing, clattering runabout."[15]

Durant decided that Republic's best chance for success lay in selling a moderately priced vehicle, not an underpowered Little or an expensive

7.2. Chevrolet, 1951. Chevrolet set its 1951 advertisements in front of American scenery, including this view of the Chicago lakefront. (National Automotive History Collection, Detroit Public Library)

Chevrolet. Durant developed a Chevrolet model that was much smaller and less expensive than Louis Chevrolet's prototype, essentially a beefed-up, rebadged Little. Seventy years later, GM did the same thing again: it sold an underpowered, Korean-made Daewoo in the United States under a name associated with racing, Pontiac LeMans. To complete the global journey, the Daewoo was actually a stripped-down version of GM's German-designed Opel.

With Durant applying his considerable marketing skills, Chevrolet was an instant success—a moderately priced car carrying the pedigree of a famous racer. Durant sold 20,000 Chevrolets in 1915, 62,000 in 1916, and 109,000 in 1919. Chevrolet rapidly moved up the GM sales chart, to eighth place in 1915, seventh in 1916, fourth in 1917, third in 1918, second in 1919. In 1914 Durant created Chevrolet's bow-tie insignia from a design that he had seen somewhere, variously attributed to a Paris hotel wallpaper pattern or to a Hot Springs, Virginia, newspaper advertisement.[16]

Louis Chevrolet was furious with Durant, believing that the rebadged Little desecrated his name. The chain-smoking Chevrolet told Durant, "I sold you my car, and I sold you my name, but I'm not going to sell myself to you. I'm going to smoke my cigarettes as much as I want. And I'm getting

out."[17] He quit the firm and went back to Switzerland, where he died in embittered obscurity.

Chevrolet's booming sales gave Durant enough cash to launch probably the most audacious scheme in automotive history, the recapturing of General Motors. Durant siphoned off Chevrolet profits to buy GM shares, which he correctly perceived as undervalued. Investors shied away from GM, because the cautious bankers running General Motors had refused to declare dividends, not wanting to jeopardize the five-year repayment schedule on the $2.5 million loan made by their banks back in 1910 to rescue the company. The bankers guarded the value of their loan by maintaining a steady annual production level of 50,000, but in an expanding market GM's market share dropped from 18 percent in 1910 to 11 percent in 1914.

Durant met GM executives in the hotel lobby before the 1915 stockholders' meeting and told them, "I'm in control of General Motors today." "You should have seen their faces," he commented.[18] His claim was slightly premature, as at the time he held 44 percent, or 71,000, of GM's 165,000 common shares. Shaken, the bankers agreed to Durant's demand for a $50 per share dividend—one of the most generous ever paid by a large U.S. corporation—but they refused his other demand, that GM buy Chevrolet. Undeterred, Durant used the dividends to buy even more GM shares.

In his brashest move of all, Durant offered GM stockholders an exchange of five shares of Chevrolet Motor Company for each of their GM shares. Having charmed enough GM shareholders, Durant announced in May 1916 that Chevrolet owned 54.5 percent of GM shares, so he truly was back in control of GM. Chevrolet, worth $20 million, had swallowed a company worth $80 million. And what was Chevrolet but a rebadged Little? When GM officially acquired Chevrolet Motor Company in 1918, the stockholders who had been charmed by Durant into exchanging five Chevrolet shares for one GM share realized very substantial profits.

Durant was elected president of GM, while retaining the same title at Chevrolet. The bankers were replaced on the board of directors with production-oriented people, such as Cadillac general manager Henry Leland and Buick president Walter Chrysler. General Motors Company—a holding company for Buick, Cadillac, and other highly autonomous manufacturing enterprises—was dissolved and reconstituted as the General Motors Corporation, with the various production facilities now organized as corporate divisions.

When Henry Ford shut down Model T production in 1927, Chevrolet became the best-selling nameplate in the United States. Ford captured that

honor six times—in 1929, 1930, 1935, 1957, 1959, and 1970—but Chevrolet held it every other year for the next sixty years, through 1989.

Pontiac. Pontiac was added to GM's roster of vehicles in 1926, when it was introduced as a lower priced version of the Oakland. The Oakland Motor Car Company had been started in 1907 by Edward M. Murphy, owner of Pontiac Buggy Company, the largest carriage maker in Pontiac, Michigan. Facing declining sales and rising labor costs, Murphy decided to build motor vehicles, with the financial assistance of wealthy lumbermen from western Michigan.

Oakland's first model, with a two-cylinder engine, was not successful, but the second, the four-cylinder Model K, was considered good value for the money, and it won several hill-climbing contests. Underfinanced, Oakland had enough cash to produce only 278 cars in 1908 and 1,035 in 1909.

Durant traveled frequently from Flint to Pontiac to visit Murphy, and praised him as an "energetic, progressive man" with organizational talents. At the same time, Durant convinced Murphy's financial backers that their investment would be safer if they traded their shares in Oakland for General Motors stock. Durant's considerable charm convinced a reluctant Murphy to sell Oakland in early 1909. A few days after the deal was completed, Murphy died.[19]

Oakland's best sales year was 1919, when 51,901 of the vehicles were sold, accounting for 15 percent of GM's total sales. Oakland sales declined to 11,852 in 1921, then rose over the next several years to a second peak of 49,668 in 1926. That year, the newly introduced Pontiac model outsold the regular Oakland, with 50,269 units sold. The division's name was changed to Pontiac Motor Division in 1931, and the Oakland name was dropped altogether in 1932.

Pontiac's early success came from attracting buyers who wanted a bit more styling and power than Chevrolet offered. Pontiac was GM's first car to be brightly painted with DuPont's new Duco, and it was the lowest priced six-cylinder car available. Pontiac was billed as "Chief of the Sixes," playing on the name of the Indian chief for whom the car's home city was named.

Pontiac's image had become decidedly stodgy by the 1950s, and its sales fell below those of GM's higher priced Oldsmobile and Buick. The brand's turnaround came under General Manager Semon E. (Bunkie) Knudsen (1956–61), son of William S. Knudsen, the division's first general manager (1932–33) and later GM president (1937–40). Bunkie Knudsen brought in

Elliott M. (Pete) Estes as chief engineer (later Pontiac general manager [1961–65] and GM president [1974–81]) and John DeLorean as assistant chief engineer (later Pontiac general manager [1965–69]).

Pontiac was given a sporty, "muscle car" image (Fig. 7.3). Most notable was the 1959 "Wide Track," in which an aggressive look was achieved by positioning the wheels slightly farther apart than on other cars and designing a split-front grille that exaggerated the car's horizontality. Pontiac moved back to second place in sales among the five GM brands during the 1960s, where Sloan's "car for every purse" strategy logically placed it.

DeLorean later claimed most of the credit for turning around Pontiac, especially after he left the company to try unsuccessfully to develop his own sports car, and he wrote a scathing expose, *On a Clear Day You Can See General Motors*. Unable to rise to the top at General Motors, Bunkie Knudsen jumped to Ford, where he served briefly as president (1968–69) before Lee Iacocca.

Oldsmobile. Oldsmobile was Durant's first acquisition after creating GM in 1908. The Olds Motor Works had been established in 1899 by Ran-

EXCLUSIVELY YOURS—*WIDE-TRACK* WHEELS
Wheels moved out a full 5 inches for the widest, steadiest stance in America—better cooling for engine and brakes—lower center of gravity for better grip on the road, safer cornering, smoother ride, easier handling. *You get the most beautiful roadability in the whole wide world!*

7.3. Pontiac, 1959. The Pontiac brand was remade in the late 1950s from a stodgy to a sporty image through such techniques as setting the wheelbase slightly wider than on other cars. (National Automotive History Collection, Detroit Public Library)

som E. Olds in Lansing. Before entering the automotive business, Olds, along with his father Pliny, manufactured gasoline engines for farm use. After failing to attract interest among Wall Street investors skeptical of the horseless carriage, Olds secured backing from S. L. Smith, a Detroit copper magnate looking to place his sons Frederic L. and Angus S. Smith in a business.

Faced with a shortage of skilled workers in Lansing, then a city of only 12,000, Olds moved production to a plant on East Jefferson Avenue in Detroit, near the Belle Isle Bridge. On March 9, 1901, a worker at the Olds factory pulled his forge underneath a gas bag. The gas ignited, and the new plant burned to the ground in an hour. Olds moved production back to Lansing, where it remained for most of the twentieth century.

After the fire, Olds concentrated on building the Curved Dash, the best-selling model in the United States between 1900 and 1904, and the first vehicle in the world to be manufactured in large volume. Legend has it that Olds chose to build the Curved Dash because it was the only model salvaged from the fire, but skeptics point out that other models could have been built from surviving blueprints.

The younger Smiths wearied of making the low-priced Curved Dash model for the masses. Following conventional wisdom at the time, they preferred larger and more luxurious models. Olds retired gracefully in 1903 from the company that bore his name, after having made a lot of money quickly. Only forty-one at his retirement, he went on to found the Reo Motor Car Company, named for his initials. Reo built cars until 1920 and trucks until 1957, when it was sold to White Motor Company, which was later taken over by Volvo-GM Heavy Truck Corporation and Volvo Trucks North America. Meanwhile, the Smiths ran Olds into the ground; sales barely topped 1,000 in 1907 and 1908.

After completing negotiations to buy the company, Durant asked Olds president Henry Russell to show him the factory. Russell asked Durant, "Do you see anything?" Durant replied, "Not a thing." Said Russell, "Neither do I."[20] Durant said he paid millions for a lot of road signs. Nonetheless, Olds was still the best-known name in the automotive industry. Songwriter Gus Edwards and lyricist Vincent Bryan had been hired by Olds in 1905 to write "In My Merry Oldsmobile," the most popular song ever written about an automobile: "Come away with me Lucille, / In my merry Oldsmobile." Oldsmobile used updated versions of the song in its advertising on and off through the twentieth century, such as this post–

World War II version: "Now's the time to take the wheel / Of a brand-new Oldsmobile."

Durant took a Buick to Olds's Lansing factory and ordered the body sawed in half lengthwise and again crosswise. Durant told the Olds workers to move around the four pieces, which were set on horses. "You can make the body any width and length you want it."[21] Thus, the first GM Oldsmobile was a stretched-out, rebadged Buick. Oldsmobile accounted for only a small percentage of GM's sales until the 1930s, when for a couple of years it was the company's second-best-selling nameplate, behind Chevrolet.

After World War II Oldsmobile attracted customers from the growing ranks of middle-class families eager to step up from a Chevrolet to get a Hydramatic transmission and a Rocket V-8 engine (Fig. 7.4). Hydramatic, the first fully automatic transmission that required no clutch, was first offered on Oldsmobile's 1940 models. The high-compression Rocket engine introduced in 1949 solidified Oldsmobile's reputation as the GM division with the most advanced engineering. Oldsmobile had lost most of its distinctive styling and engineering by the 1970s, yet it retained a strong brand appeal among upwardly mobile middle-class families for another decade. When sales exceeded 1 million in 1978 and again in 1983–86, Oldsmobile joined Chevrolet and Ford as the only three makes of car to achieve that level in one year in one country during the twentieth century.

Consumers finally tired of a succession of undistinguished cars, and Oldsmobile sales plummeted to 289,172 in 2000. In an attempt to revive the nameplate, Oldsmobile was repositioned during the 1990s as a "domestic" alternative to imported cars, and individual model names were changed. But the changes managed only to alienate the brand's traditional older buyers, while failing to attract new, younger ones. Concluding that a revival of Oldsmobile's fortunes was impossible, GM killed the brand in 2001.

Buick. Buick formed the strong backbone of General Motors in its turbulent early years. Buick had been founded in 1902 by David Dunbar Buick, senior partner in the firm of Buick & Sherwood, a Detroit manufacturer of plumbing supplies. David Buick had developed a method of fixing porcelain to metal, the key to manufacturing low-cost, modern bathtubs.

Buick gained a reputation as a well-engineered vehicle and was widely known as "the" Buick. But David Buick, "a man of brilliantly progressive

AUTOMOBILES
"88"
THE Car of the Year!
ROCKET! ROCKET! ROCKET!
"88" Popularity Soars to New Highs!
*Hydra-Matic Drive, at reduced price, now optional on all models.
Up . . . up . . . up goes the "Rocket" in public acclaim! From the day of its introduction, Oldsmobile's "Rocket 88" has been a popular car! Today, the "88" is far more than that! It's now a standout car—a standout in performance—in popularity—in sales leadership! What's more, Oldsmobile dealers look forward to an even greater future for the exciting "88" . . . especially now that it offers a new one-piece windshield! With its famous "Rocket" Engine, ultra-smooth Hydra-Matic Drive*, and sparkling Futuramic styling—the Oldsmobile "88" is truly the car of the year! That's why Oldsmobile dealers everywhere are demonstrating these facts as never before in the new, nation-wide "Make a Date with a Rocket 8" campaign!
OLDSMOBILE
A GENERAL MOTORS VALUE

7.4. Oldsmobile, 1950. Oldsmobile advertisements after World War II emphasized its "famous 'Rocket' Engine, ultra-smooth Hydra-Matic Drive, and sparkling Futuramic styling." (National Automotive History Collection, Detroit Public Library)

ideas, native mechanical ability, and little business caution," lacked capital to build the Buick in large quantities.[22] He borrowed considerable sums from Frank and Benjamin Briscoe, then manufacturers of sheet metal who were supplying radiators to Oldsmobile. After investing nearly $100,000, the Briscoes took control of the Buick, then decided to sell it. While visiting relatives in Flint, Frank Briscoe heard from Dwight T. Stone, a local real es-

tate agent and son of one of Flint's early industrialists, that James H. Whiting, president of Flint Wagon Works, might be interested in buying it.

Flint, then a city of fewer than 14,000 inhabitants, was located at the ford, or "Grand Traverse," of the Flint River, whose upper reaches extended for many miles through one of the best stretches of Michigan's pine forests. A natural site for lumber mills, Flint by 1895 had become the center of the nation's carriage industry. But wagon makers like Whiting realized that the future was in the horseless carriage. He bought the Buick's machinery, patterns, and dies for $75,000 and began to build cars at his wagon works factory in west Flint. Sixteen Buicks were built in 1903, thirty-seven in 1904.

Whiting decided that he needed a younger man to run the Buick, but viewed neither David Buick nor his son Thomas Buick as capable. David Buick was shunted off to a quiet workshop and in 1906 left the company that bore his name. He became involved in a series of unsuccessful business ventures, and for the last two years of his life was an instructor and clerk at the Detroit School of Trades. He died penniless in Detroit in 1929 at age seventy-four, having received no money from General Motors, not even an annuity. Thomas Buick founded a tire company in Flint but "dropped out of sight" after 1908.[23]

Whiting received a suggestion from F. A. Aldrich, an official of the Durant-Dort Carriage Company, also based in Flint, that he talk to Durant about running the Buick. Durant agreed in November 1904 to become general manager and director of the struggling company, apparently motivated by the adverse impact on his native Flint's economy should the Buick collapse.[24] Under Durant's leadership, Buick became the best-selling car in the United States in 1908 and 1909, and GM's best-selling car until 1918, when Chevrolet took over that position. Buick remained one of the most popular nameplates in the United States and, more important, the best seller among higher priced cars, which yielded high profit margins.

Styling was especially important to Buick's marketing success, especially under the long leadership of general manager Harlow H. Curtice (1933–48). Consumers were attracted to models designed by Harley Earl that featured a sawtoothed front grille and several nonfunctional portholes on the front fenders, three on each side for the lower priced models and four for the highest priced Roadmaster (Fig. 7.5).

Cadillac. In 1909 Durant bought the Cadillac Automobile Company, which had been founded in 1901 as the Henry Ford Company. Ford quit the

7.5. Buick, 1955. Cars in the 1950s were often photographed with beautiful women who had little or no involvement in the vehicle's operation. The most distinctive styling element of Buicks during this era was the series of useless portholes in the front fenders. (National Automotive History Collection, Detroit Public Library)

company in 1902 after his impatient backers brought in Henry Leland as production consultant. The company was renamed for Antoine de la Mothe Cadillac, who had founded Detroit in 1701, with Henry Leland as president and his son Wilfred handling the finances.

Leland brought to Cadillac a reputation for precision machining, such as boring cylinders and pistons to closer tolerance than other companies. His Leland & Faulconer Company, a manufacturer of machine tools and marine engines, had supplied 2,000 engines to Oldsmobile after its factory burned. Cadillac's ability to make high-quality parts received international attention in 1909, when it became the first U.S. company to win the Dewar Trophy, awarded annually to the company showing the most important automotive advance. Funded by Britain's Sir Thomas Dewar, the whiskey magnate, the trophy had previously been awarded only to European companies. Until Cadillac's feat, most European car enthusiasts assumed that U.S. firms could not match the quality of engineering achieved in Europe. Frederick S. Bennett, an employee of the Anglo-American Motor Com-

pany, responsible for importing, selling, and servicing Cadillacs in Britain, convinced the Royal Automobile Club (RAC) to conduct a test to show that Cadillac's parts were interchangeable.

The RAC claimed that a test was pointless, because the premise—that parts could be interchanged—was infeasible. Bennett persisted, figuring that British customers reluctant to buy an imported car might be convinced if Cadillac could demonstrate that repairs were simple, thanks to cheap, abundant, and, most important, interchangeable parts. The RAC finally agreed to the test, probably to prove Bennett foolish. All manufacturers were invited to participate, but in the end only Cadillac took part.

On February 29, 1908, RAC representatives selected three of the eight Cadillacs in the Anglo-American Motor Company's London showroom and drove them 50 miles, including 27 miles at high speed (34 mph average) around the Brooklands speedway track. Two days later Bennett's mechanics began to disassemble the three Cadillacs, using only wrenches, screwdrivers, hammers, and pliers. After three days of taking everything possible apart, the mechanics had 3 piles with 721 pieces each. RAC representatives mixed up the parts, replaced 89 of them with spares from Bennett's stock, and sorted out the 2,163 parts into 3 fresh piles. Over the next several days, Bennett's mechanics reassembled three vehicles into working order. The vehicles were driven 500 miles around the Brooklands track, demonstrating the durability as well as the interchangeability of the parts. Cadillac went on to become the first company to win the Dewar Trophy a second time, in 1913, for introducing the electric self-starter on its 1912 models.

Negotiations between Durant and Leland were drawn out. Leland agreed to sell in 1908, but the deal fell through because he demanded cash. When Durant returned in 1909 with the cash, he raised the price. In the final deal, Leland took some GM stock and complete control over managing Cadillac. Over the next decade, Durant honored his verbal pledge to leave Cadillac management to Leland.

Extremely patriotic and a serious Anglophile, Leland asked Durant, the day after the United States entered World War I in 1917, for permission to build airplane engines at a Cadillac plant. Durant flatly refused, claiming that "this war should stop tomorrow." Leland quit Cadillac and a few weeks later started the Lincoln Motor Company to build Liberty airplane engines. Leland built Lincoln cars beginning in 1920, with the same standard of luxury and craftsmanship as the Cadillac, but when Lincoln was not financially successful, he sold it to Ford in 1923. Thus, Leland was respon-

sible for initiating America's two surviving luxury nameplates, first Cadillac and then Lincoln.[25]

Cadillac and Packard jockeyed for leadership among luxury car sales in the United States. Packard outsold Cadillac every year from 1925 through 1949 except for 1947, but Cadillac passed Packard in 1950. By 1957 Packard was extinct, having been unable to keep up with Cadillac's styling in the 1950s, especially the tailfins that Harley Earl introduced on 1948 Cadillac models (Fig. 7.6). The 1959 Cadillac tailfins may have been the most extravagant automotive design ever.

A Social Class Pyramid

GM realized the full fruits of its three decades of class-based marketing in the 1950s. For example, in 1959 GM sold 2.5 million cars, of which 56 percent were Chevrolet, 15 percent Pontiac, 14 percent Oldsmobile, 10 percent Buick, and 5 percent Cadillac. When graphed by price, the company's sales resembled a pyramid, with higher sales for lower priced Chevrolet at the base and lower sales for higher priced Cadillac at the top.

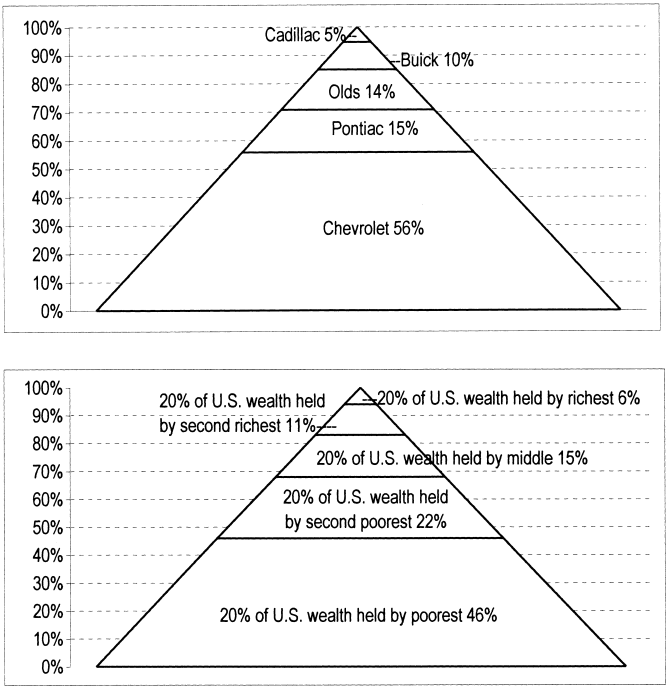
Comparing the pyramid of GM sales to the distribution of household income in the United States reveals the full success of the company's class-based marketing strategy: If the wealth of the United States at mid-century were divided into five equal portions, one-fifth was held by the poorest 46 percent of the population, one-fifth by the next poorest 22 percent, one-fifth by the middle 15 percent, one-fifth by the second-richest 11 percent, and one-fifth by the richest 6 percent. A chart with income on the y-axis and number of people on the x-axis thus also resembled a pyramid, with a large number of Americans occupying the base and a handful of wealthy people at the top.

Displaying the distribution of social classes during the 1950s as a pyramid with five quintiles thus gave almost exactly the same shape as sales of GM's five nameplates at the time. The percentage of GM's overall sales accounted for by Cadillac virtually matched the size of the wealthiest group of the U.S. population, and the share of Buick and Oldsmobile buyers virtually matched the size of the next two groups. Had GM sold a few more Pontiacs instead of Chevrolets, the two pyramids would have been virtually identical from top to bottom (Fig. 7.7).

GM positioned its products to conform closely to the pyramid-shaped distribution of U.S. social classes, with a broad base and narrow top. It created a hierarchy of cars, differentiated by price, that appealed to people

7.6. Cadillac, 1955. Cadillacs were placed in scenes of luxury during the 1950s. The advertising copy read, "The handsome couple you see in the beautiful picture above have just made a very wise decision. They have decided to get the facts about Cadillac—to see if, perhaps, the time has come for them to make the move to the 'car of cars.'" (National Automotive History Collection, Detroit Public Library)

in every social class. Chevrolet supplanted Ford as the best-selling car for first-time buyers. Pontiac offered a bit more flair and style at the lower priced end. Oldsmobile claimed superior engineering for the upwardly mobile family. Buick appealed to doctors, lawyers, and managers. Cadillac was reserved for the rich.



7.7. General Motors social-class pyramids: (top) Sales of GM's five car brands, 1955. The pyramid displays brands in descending price order, from luxury Cadillac at the top to entry-level Chevrolet at the bottom. Numbers are the percentages of total GM sales accounted for by each brand. (bottom) Income distribution of U.S. households, 1955. The pyramid divides the wealth of the United States into five equal portions. The two pyramids have nearly identical shapes, showing that GM had positioned its five brands in close accordance with the size of different income groups in the United States at that time.

The Rise and Fall of a Monopoly

Durant tried to charm other producers into joining him in creating an automotive monopoly, or trust as it was then called. John D. Rockefeller had created the Standard Oil Company trust to control petroleum production and distribution; J. P. Morgan had set up the U.S. Steel Corporation trust to control steel production; and Col. Albert A. Pope had established the American Bicycle Company trust to control bicycle sales.

An especially prominent monopoly in 1900 was the mode of transportation that the motor vehicle was destined to supplant—the railroad. Seven

groups—Vanderbilt, Pennsylvania, Morgan, Gould, Moore, Harriman, and Hill—controlled two-thirds of U.S. rail service in 1900. To most Americans, railroad companies were hated and feared monopolies run by haughty, insensitive robber barons unresponsive to the public interest. Rather than lower prices, U.S. railroad companies concentrated on luxurious service for their high-income clientele. As long as the train's principal land-based alternative was horse-drawn coach, the monopolistic railroad companies could get away with charging high fares. Once the motor vehicle offered comparable speed at one-half the price, the railroads were finished. A century later, arrogant, monopolistic General Motors would also fall primarily from self-inflicted wounds.[26]

Durant and Benjamin Briscoe, head of the Maxwell-Briscoe Motor Company, organized a series of secret meetings in Detroit and New York, attended by Henry Ford, R. E. Olds, and other leading producers, to discuss a giant merger. The J. P. Morgan & Company bank, a major backer of Briscoe, was interested in financing an automotive industry trust "to save it from death by competition."[27] Negotiations had reached the final stage, when Henry Ford demanded cash rather than stock in the new company; he would sell for $3 million but would not merge. This had been Ford's position all along, but Briscoe and Durant had hoped they could change his mind. When Olds also demanded cash, Durant and Briscoe continued merger talks alone.

Morgan agreed to underwrite the Durant-Briscoe merger, but it insisted that Buick stockholders first be formally polled. Durant responded that he already held authority from his stockholders, who in any case were mostly his friends and would have supported anything he did. Having reached a stalemate, the deal died. A few days later, on September 16, 1908, Durant incorporated a holding company, selecting the name General Motors Company because he couldn't use the name that the Morgan-backed trust had selected, International Motors. The birth of General Motors was never formally announced; incorporation papers were filed in a way to avoid publicity, and Durant refused to talk to the press about the holding company. "Flint just gradually came to know vaguely about GM," as GM historian Richard Scharchburg put it.[28]

GM's Near Monopoly

Innovative accounting turned GM's "car for every purse" strategy into enormous profits and gave the company a near-monopoly position in the U.S. market. Durant had measured success by the selling price of GM's

shares on the stock exchange. He believed that the way to maximize revenue was to sell more cars and increase market share. Sloan observed, "While it would be unfair to say that Mr. Durant did not believe in accounting, yet it would be fair to say that he didn't understand or believe in the wonderful possibilities of accounting in terms of indicating what ought to be done in the administration of the business."[29] Durant "wrestled many times with the business cycle without apparently becoming convinced of its periodicity. . . . While he could make money in his operations and raise a good deal of money by his personal force and the confidence which he inspired, he never seemed able to budget his operations accurately in advance and built up reserves."[30]

When it took control of GM, DuPont installed its accounting system. The fundamental measure of performance at GM was the rate of return on invested capital. This has been described as "in simplest terms . . . the percent figure that results from dividing dollar profits by the total dollar equivalent of working capital, plant, and equipment used to generate those profits. . . . Rate of return is not a dollar figure; it is a rate or a ratio of dollar numbers to other dollar numbers."[31]

Under DuPont management, GM was not committed to selling a large number of cars per year "merely for the edification and amusement of the manufacturing and engineering departments," said Albert Bradley, one of GM's financial leaders in the 1920s and later chairman of the board. "The stockholders themselves must also get a run for their money," he continued. "The true basis for measuring the commercial success of any enterprise . . . is the return on the capital employed."[32] GM's average annual return between 1946 and 1967 was 14.67 percent on total assets and 20.67 percent on net worth. In comparison, other car makers averaged 9.76 percent on total assets and 9.41 percent on net worth during that period, and all U.S. manufacturers averaged 6.64 percent on total assets and 9.02 percent on net worth.[33]

Donaldson Brown, DuPont treasurer and husband of a du Pont, was placed in charge of adapting DuPont's system to GM. He identified the critical financial variables that affected the rate of return on investment, and came up with the formula:

$R = T \times P$

where R = rate of return on invested capital;

T = rate of turnover of invested capital; and

P = percent of profit on sales.

Rate of turnover of invested capital was a ratio of sales to investment. Investment included permanent or fixed-capital variables, such as plant and equipment, and working-capital items, such as cash balance, inventories, and accounts receivable. Percent of profit on sales was computed by subtracting the cost of sales (administration, advertising, and production) from net sales, then dividing by net sales.[34]

For the next several decades GM used the rate of return on investment to monitor the performance of its many operating divisions, as well as that of competitors. Each operating unit was required to demonstrate each month that its rate of return on investment met the corporatewide target of 20 percent. Division managers were given considerable latitude in determining how to achieve this goal, which led to some unsavory practices, such as speeding up the line to increase the productivity of the work force.[35] Top executives shaped the corporation's basic strategic directions, while individual units managed day-to-day operations with minimal interference. Under Durant, GM had not had an organization. "He operated in a purely personal way between the different executives, particularly in charge of the car operations, and himself," according to Sloan. "Practically everybody . . . reported to [Durant] directly."[36]

GM established a so-called "standard price" it wished to receive for each of its products, including a 20 percent return on investment. The corporation then forecast the number of vehicles that it could sell in the coming year at standard prices and ordered only that number to be built. The approach secured GM a high rate of return year in and year out, regardless of whether sales were up or down in a particular year. "The question is not simply one of maximizing the rate of return for a specific short period of time. Mr. Brown's thought on this was that the fundamental consideration was an average return over a long period of time."[37] By keeping estimates of demand realistically conservative, GM could achieve its targeted profit rate even if its plants operated at only 64 percent of capacity. In peak demand years, the company could increase production and realize a rate of return on investment above 20 percent.

Had it engaged in aggressive price cutting, GM might have driven every other car maker out of business. Instead, GM used its dominant position in the market to raise prices. Having decided as early as 1937 that it could not let its market share exceed 50 percent without running into antitrust problems, GM was content to let the other companies share the other 50 percent of the market.

GM's dominance was demonstrated especially clearly in 1956. In that

year Ford introduced newly engineered models, yet announced only a modest price increase from 1955 of 2.9 percent, about $50. GM then revealed that the 1956 Chevrolet, with only cosmetic changes from 1955, would be priced $50 to $166 higher, depending on the model. Ford then raised its prices by an average of another $50 to within $10 of the comparable Chevrolet models. If Ford had stuck to its initially announced lower prices, it could have captured a higher market share in the short run. But in the long run, GM could reclaim its market share by lowering prices to levels that would cripple Ford. Ford preferred to take higher profits on lower volume, rather than risk a price war with GM that it would surely lose. The average wholesale price of a new car increased during the 1950s by 43 percent, from $1,270 in 1950 to $1,822 in 1960—twice as fast as the rate of inflation.[38]

GM even found a way to benefit from its competitors' sales, as a major supplier of components. By far the world's largest parts maker, GM made a profit by selling to Ford, Chrysler, and the smaller manufacturers spark plugs, bearings, and other small parts, as well as major components, such as air conditioners and automatic transmissions. When a fire at its Livonia plant in 1953 drastically reduced its capacity to produce automatic transmissions, GM made certain that Chrysler got its normal allocation first, while GM's own car-making divisions suffered short-term shortages and reduced market share that year.

One reason why foreign-owned companies successfully entered the U.S. market in the late 1950s and again in the 1970s was that GM opened the door to let them in. Regarding half of the U.S. market as its rightful share, GM was happy to see healthy firms competing for the other half. In the words of one automotive industry chronicler, "industrial dominance had imbued General Motors with magisterial arrogance and smug assurance."[39]

GM's arrogance reached its peak during the 1960s in its handling of Ralph Nader. As one U.S. senator put it, "everybody is so outraged that a great corporation was out to clobber a guy because he wrote critically about them. At that point, everybody said the hell with them."[40] Nader's book, *Unsafe at Any Speed,* published in 1965, argued that the Big Three, especially General Motors, were more concerned with making higher profits than with making their products safer. The book interspersed lofty public statements by auto company executives about designing safe cars with descriptions of gruesome accidents that might have been prevented with the addition of inexpensive safety features.

Nader pulled examples from all three of the major car makers, but most of his criticism was directed at GM's Chevrolet Corvair (Fig. 7.8). Nader charged that the Corvair had a tendency to roll over because of its design, especially the absence of a stabilizing bar between the front wheels. GM produced 1.5 million Corvairs between 1960 and 1965, but after publication of Nader's book, production plummeted to 100,000 in 1966, 28,000 in 1967, 15,000 in 1968, and 6,000 in 1969, its last year.

Stung by Nader's attacks, GM officials decided to fight back by smearing him. Instead, they ended up making him a hero and a potent long-term force in the consumer safety movement. GM chief counsel A. F. Power hired detectives to investigate Nader's background, credentials, and qualifications, not an unusual step in legal proceedings. But when nothing damaging was found, Power ordered a second, more intensive investigation that exceeded the bounds of proper legal inquiry; detectives were assigned to tail Nader and to check into his private affairs. In Nader's personal life, GM thought it had found the material to discredit him. Nader, then in his early thirties, was living in what many Americans—and cer-

7.8. Chevrolet Corvair and Impala, 1960. GM introduced the Corvair in the 1960 model year as a smaller, sportier alternative to the full-sized model in the background. (National Automotive History Collection, Detroit Public Library)

tainly GM executives—found eccentric conditions: a Harvard Law School graduate, with the opportunity to earn a fortune as a lawyer, Nader instead set himself up as a public interest attorney and moved to Washington, D.C., where he lived in near pauper conditions in a roominghouse, earning barely enough money to avoid starvation by writing magazine articles. He was also serving as an unpaid consultant to a Senate subcommittee investigating auto-related deaths. But GM embellished the unspectacular reality of a hard-working ascetic with lurid and sinister tales of Nader's alleged homosexuality and anti-Semitism.

An outraged U.S. Senate subcommittee hauled GM president James Roche into a public hearing in 1966, where he apologized for conducting the investigation and denied that GM had discovered any derogatory information about Nader. Unmollified, Congress, later that year, enacted the National Traffic and Motor Vehicle Safety Act, which empowered the National Highway Safety Bureau to set standards for automotive safety and order recalls of vehicles with safety-related defects. As for Nader, he sued GM for $6 million in compensatory damages and $20 million in punitive damages, settling out of court for $425,000. After paying his $141,000 legal fees, Nader turned over the remainder of the settlement to consumer advocacy programs.

Before tangling with GM, Nader had known little about the auto industry, and—as GM let the entire country know—he didn't even own a car, a sure sign of an unpatriotic American in the eyes of GM in the early 1960s. Concerned with auto industry indifference to the high incidence of injuries to motorists, Nader collected information about accidents involving Corvairs and sent it free to attorneys around the country. GM soon was facing more than a hundred suits alleging that the design of the Corvair had contributed to motorists' injuries. Nader drew much of the material for his book from testimony at these trials.

Almost lost in the public disgust over GM's smear campaign was the basic veracity of Nader's charges against the Corvair. Unfortunately (from GM's perspective), the record contained ample evidence that GM officials knew about the Corvair's tendency to roll over but chose to produce it anyway. The first GM driver to test a Corvair prototype rolled it over. The first Ford driver to test a Corvair in 1960—companies routinely obtain early versions of competitors' models—also rolled it over, but Ford aggravated the problem by keeping quiet about it for fear of retaliation by powerful GM against some of its own less-than-perfect models.

The Corvair's rollover problem stemmed in part from a faulty design:

with the engine, and therefore most of the weight, in the rear, the car tended to jackknife in sharp, high-speed turns or stiff crosswinds, inducing the driver to compensate by oversteering, resulting in loss of control. But GM officials had aggravated the oversteering problem through cost-cutting measures. By eliminating a front-end stabilizing bar, GM saved $15 per car, and equipping the Corvair with undersized tires saved another $1. Roche was forced to testify at a Senate hearing that GM had spent only $1.25 million the previous year on safety while accruing $1.7 billion in profits.

The problems with the Corvair triggered a battle within GM, according to John DeLorean, then general manager of the Pontiac division. Bunkie Knudsen turned down promotion to the position of Chevrolet general manager in 1961 until he was permitted to correct the Corvair problems, beginning with the 1964 models. But by then it was too late to save the car's reputation.[41]

Rate of return on investment had dominated decisions about GM cars for decades before the Corvair. In 1929 GM president Sloan had been urged to introduce safety glass by officials from DuPont, which manufactured the plastic inner lining for the glass, but Sloan had refused: "Accidents or no accidents, my concern in this problem is a matter of profit and loss. . . . [T]he advent of safety glass will result in . . . absorbing a very considerable part of the extra cost out of our profits. . . . [Installing safety glass] would have reduced the return on . . . capital." Three years later, Sloan was still fighting DuPont: "[I]f we adopt safety glass it will be very materially at the expense of the stockholders."[42] Sloan believed that the corporation had no responsibility for looking after the general welfare of the population, because it had no public authority.[43] Corporations were ill advised to stray from their central mission of providing their shareholders with an acceptable rate of return on investment.

Sloan was a remote, intense man of ascetic appearance, 6 feet tall and weighing only 130 pounds. Partially deaf, Sloan appeared to be an especially intense listener when others spoke. He had no hobbies, disliked recreational reading, considered golf and other sports a waste of time, didn't smoke, and rarely drank; business was his one consuming interest. Carefully separating his interests, convictions, and personal life from his profession, he avoided social contacts with business associates and kept business relations formal. His associates said Sloan resembled the roller bearings he once manufactured—self-lubricating, smooth, eliminator of friction, and load bearer.[44] Privately, the childless Sloan left an imprint on major U.S. charities, including the Sloan-Kettering Cancer Hospital (which

he founded with Kettering), the Sloan Foundation, MIT, and the Kettering University engineering school.

Seeing the Future

GM as a company hardly inspired love—though it may have inspired respect or fear. But GM's products in the 1950s were loved. A half-century later, critics have been harsh on the U.S. car makers of the 1950s, and GM in particular:

> By the 1950s, General Motors was a monster, a smug and secure empire.[45]

> The industry indulged in an orgy of nonfunctional styling that subordinated engineering to questionable aesthetic values.[46]

> No styling innovation seemed more emblematic of this golden age of the automobile industry . . . than the great jutting, thrusting, and chromed fins that sprouted on the rear fenders of automobiles. . . . That tail fins were deadly weapons mattered not at all.[47]

> Welcome to the 1950s, an outlandish, ostentatious and glittering era of high style and American muscle. It was the day of tailfins, big slabs of chrome, gunsight taillights, greenhouse canopies and eye-assaulting color combinations such as salmon pink with turquoise.[48]

Sure, the 1950s cars placed styling ahead of engineering, form ahead of function, whimsy ahead of practicality. Under Harley Earl, then Billy Mitchell, GM designers had wide latitude to design vehicles as they wished. After World War II, they chose to design cars that resembled jet planes and rockets. And GM had the marketing might to sell whatever Earl and Mitchell designed.

But Americans loved their 1950s cars, and they especially liked GM's styling (Fig. 7.9). GM gained market share at the expense of Chrysler and the smaller companies in the late 1940s and 1950s largely because it had designed cars that people found attractive, while Chrysler's postwar cars appeared stodgy and old-fashioned. When Chrysler finally turned out attractive cars in 1957, the build quality was so abysmal that disgruntled customers went back to GM products.

Even today, many look back fondly on the 1950s cars:

> The '57 Chevy Bel-Air. The '51 Ford Crestliner. The '62 Oldsmobile Starfire convertible. The '47 Buick Roadmaster. The '54 Hudson Hornet. The '63 Pontiac Bonneville. The '59 Cadillac Fleetwood. . . . The mere mention of those cars quickens the pulse of every person who used to drive one (or, as a child, ride in one).[49]

7.9. Cadillac tail fins. The fins grew increasingly bold during the 1950s, culminating with the 1959 model. (National Automotive History Collection, Detroit Public Library)

> If there has arrived on this planet a better looking bouquet of machinery than the American automobile '55 to '60, I haven't yet seen it.[50]

General Motors sold half the cars in the United States from the 1930s through the 1960s because it knew what Americans wanted: attractive, muscular vehicles, and plenty of uncongested highways. And when the American class structure changed from a broad pyramid of working-class families in the 1920s, to a bulge of middle-class families in the 1950s, sales of GM's middle-range Pontiac, Oldsmobile, and Buick models soared. "Customers may have been manipulated by advertisements, but when Dinah Shore and Pat Boone sang 'See the U.S.A. in your Chevrolet' on television in the 1950s, Americans responded. . . . [N]o one could ever imagine Dinah Shore singing: 'See the U.S.A. in your Honda Civic.'"[51]

A quarter-century after the 1939 World's Fair closed—a critical though not a financial success—New York City staged another World's Fair, in 1964–65. General Motors brought back its Futurama. Depression-era children, inspired by the 1939 Futurama, brought their baby-boomer children to see the future again. This time they were disappointed. Once again, Futurama visitors sat in high-backed chairs, this time plastic, that moved along a track, while a confident narrator again described and explained a passing scene. But this time, instead of the United States, Futurama took visitors to the moon, Antarctica, the ocean floor, a desert, and a jungle. Tellingly absent from GM's 1964 Futurama tour of exotic locations was a corporate vision for the future of the United States, the company's home market.

Careful readers of the 1964 fair's official guide could find an advertisement that forecast the future more accurately than the Futurama. The ad invited fairgoers to visit a small exhibit on the mezzanine level of the Japan Pavilion Complex building number two, featuring Datsun cars, made by Nissan Motor Corporation. Nissan had sold fifty-two Datsuns in the United States in 1958. It would record its one-hundred-thousandth U.S. sale in 1967, its one-millionth in 1973, its ten-millionth in 1990.

GM conveyed a clear message in 1939: this is what we want for America at mid-century—join us in making it happen. When GM's vision resonated with the public, much of it was realized. In 1964 GM conveyed an even clearer vision for the late twentieth century: don't change a thing, we're quite happy with the present state of affairs. Given that the 1964–65 World's Fair fell in the midst of a decade of assassinations, civil rights marches, urban disorders, white flight, and protests against an unpopular war in Vietnam, GM's stand-pat message was more than a little wide of the mark. If the 1939 Futurama presaged GM's dominance, the 1964 Futurama gave warning of its downfall.

8 . . . *To a Personal Market*

Build up, build up a highway! Clear a road! Remove all obstacles from the road of My people!

—Isaiah 57:14

For nearly half a century the term *Edsel* has had a clear meaning in the United States: an expensive, ill-conceived failure. The Ford Motor Company introduced the Edsel car in 1957 to compete against GM's long-successful "car for every purse" strategy. Before its introduction, Edsel generated so much popular interest that *Newsweek* magazine teased its readers by running a photograph of just the fender on the cover of its June 10, 1957, issue.

Ford killed the Edsel less than three years after its introduction. The failure was attributed to poor design and bad luck, but from a longer perspective, Edsel's swift death appears as the first casualty in the collapse of the entire "car for every purse" paradigm that had dominated the U.S. auto industry since the 1920s.

Ford introduced Edsel to help its outgunned Mercury compete in the profitable mid-priced market during the 1950s. Ford did well at the low-priced end of the automotive ladder of success; in 1957, the Ford nameplate outsold Chevrolet for the first time since 1935. But the rest of Ford's lineup performed abysmally against GM and Chrysler. Ford's mid-priced Mercury was outsold two to one by Chrysler's three mid-priced cars (Dodge, DeSoto, and Chrysler) and four to one by GM's three mid-priced cars (Pontiac, Oldsmobile, and Buick).

In a sense, it was appropriate that an ill-fated car was named for Edsel Ford, only son of Henry Ford and father of Henry Ford II, the company's president when the new car was being developed. Edsel Ford's relationships with both his father and the company were painful. After buying up 100 percent of the shares of the Ford Motor Company in 1919, Henry Ford

had named twenty-five-year-old Edsel president, though he believed his son to be weak and spineless, unequal to the challenges of the era. A terse and inarticulate man, Henry Ford was not disposed to public displays of affection or words of kindness toward his son. Convinced that his own judgment was infallible, Henry Ford ignored his son's advice in the two areas that would prove most crucial in Ford's decline. First, Edsel Ford argued unsuccessfully in the early 1920s that Ford should terminate production of the aging Model T and bring out more competitive, up-to-date models instead. Then he was frozen out of most labor relations issues during the 1930s, because his father viewed him as too sympathetic toward union organizers and collective bargaining. Broken by the stress of failing to modernize the company or win his father's respect, Edsel died of undulant fever and stomach cancer in 1943, at age forty-nine. He left behind a company run by gangsters and an irrational old man, until it was rescued by his widow, his mother, and his young son Henry II. No wonder that the Ford family was opposed to naming the car for Edsel, a martyr to his father's distinctive mix of genius and ignorance.

Other than its name, the Edsel car failed for three, more substantial reasons. First, it looked funny. Dominating the front end was a vertical grille likened to a horse collar, at a time when nearly all cars had horizontal grilles. The taillights were shaped like the letter J, rotated 90 degrees, and they were horizontal when nearly all cars had vertical tailfins (Fig. 8.1). Second, the Edsel was poorly built, even by the era's low standards. Originally intended to be an entirely new design, the Edsel cannibalized bits of Ford and Mercury to save development costs. The two higher priced Edsel models shared a chassis and assembly line with Mercury, while the two lower priced Edsels were built on Ford Division assembly lines with a Ford chassis. Edsels were built in small batches at the end of the day by tired workers, after they had finished work on the Fords and the Mercurys. Third, the market for mid-priced cars collapsed in the late 1950s. Sales of the Big Three's mid-priced cars dropped from nearly 2 million in 1957 to 1 million in 1961.

Ford pulled the plug on the Edsel after just two years and only 115,000 lifetime sales. Unable to offer the Edsel as a credible alternative to GM's ladder of success, Ford was relegated to selling primarily icons for the working class. GM's mid-priced Pontiacs, Oldsmobiles, and Buicks remained shiny trophies of professional success that middle-class men could bring home to their appreciative wives and children as they advanced up the corporate ladder.

DRAMATIC EDSEL STYLING leads the way
–in distinction, in beauty, in value!
Last August, the photograph above could not have been taken. The Edsel car was still a secret then. But in one short year, Edsel's outstanding design has become as familiar as it is distinctive. In fact, you can recognize the classic Edsel lines much faster, much farther away, than you can any other car in America! This extra value in advanced styling accounts for the many more Edsels you've been seeing on the road lately.
And proud new Edsel owners are getting plenty of extra value inside their cars, too—the ease of Teletouch Drive, the power and economy of the all-new engines, the convenience of self-adjusting brakes, the comfort of contour seats. And the satisfaction of having made a great buy. For there's less than fifty dollars difference between the magnificent Edsel and V-8's of the major low-priced makes.*
Why not see your Edsel Dealer this week for sure?
EDSEL DIVISION • FORD MOTOR COMPANY
Less than fifty dollars between Edsel and V-8's of the major low-priced makes

8.1. Edsel, 1958. The first Edsel model was out of step with styling of other cars. The front had a vertical shape when other cars were horizontal, and the rear was horizontal when other cars had tail fins. (From the collections of Henry Ford Museum & Greenfield Village)

The U.S. motor vehicle market was organized at mid-twentieth century into a clearly stratified social class structure. By the end of the twentieth century, the "car for every purse" strategy had been destroyed, replaced by a much more fragmented and segmented market. The change took place over several decades. During the 1960s cars appeared in a variety of sizes.

The segmentation of the U.S. market by size helped U.S. manufacturers compete against small-car specialists, such as Volkswagen, but it muddled the clear, class-based market positions of their full-sized cars. During the 1970s the energy crisis pushed Americans into buying cars based on fuel economy rather than on social class appeal. The market for the full-sized models, which for a half-century had defined social class differences, permanently disappeared as Americans turned to smaller, more fuel-efficient models made by Japanese companies. During the 1980s, as memories of the energy crisis faded, U.S. consumers increasingly distinguished cars on the basis of quality. By building poor-quality vehicles while clinging to the outdated, class-based segmentation, U.S. manufacturers lost sales to well-built Japanese models. During the 1990s, as differences in quality narrowed and gasoline was cheap, American consumers were attracted to the power, large size, and rugged styling of trucks. During the 2000s, faced with pollution-reduction mandates and higher petroleum prices, Americans may increasingly turn to alternative-fuel vehicles.

Size Segmentation in the 1960s

GM built five brands during the 1930s, 1940s, and 1950s on only three different chassis, all roughly the same length: a so-called A-body for Chevrolet, a B-body for Pontiac and most Oldsmobiles and Buicks, and a C-body for Cadillac and top-of-the-line Oldsmobiles and Buicks.[1] Ford and Chrysler had similar strategies. Customers perceived that marginal engineering differences were significant because each of the five nameplates had a clear social class position. Thanks to imaginative styling, no fewer than seventy-five different body shapes and trim levels were placed on top of the three chassis.

Domestic car makers in the 1950s were aware that a market existed in the United States for small cars. A Society of Automotive Engineers survey conducted near the end of World War II found that most buyers in four urban areas wanted smaller, less expensive, and more functional automobiles. General Motors, having obtained similar findings, announced in 1945 that it would sell a $1,000, four-passenger car, called the Cadet, based on a 1935 Chevrolet, which was 1 foot shorter than the immediate prewar and postwar full-sized Chevrolet. The Cadet was killed in 1947 by GM executives concerned that a small car would yield a lower rate of return on investment than larger cars and would compete against GM dealers' lucrative used car sales.[2]

Several U.S. companies did begin production of small cars after World War II, including Crosley, Kaiser-Frazer, Nash, and Willys-Overland, and companies other than the Big Three captured one-fifth of the market in 1948 (Fig. 8.2). After the other independent companies had failed, American Motors, created in a 1954 merger between Hudson and Nash, staved off extinction by selling small cars as an alternative to what AMC president George Romney called the Big Three's "gas-guzzling dinosaurs."[3] Small-car

8.2. Willy, 1951. Companies such as Willys-Overland tried to compete after World War II by offering vehicles that were smaller and got better gas mileage than those sold by the Big Three. In an era of cheap gas and rising incomes, however, few consumers were interested in small, energy-efficient vehicles. (National Automotive History Collection, Detroit Public Library)

sales, led by AMC's Rambler and several European products, reduced the Big Three's market share from 93 percent in 1957 to 82 percent in 1959.

Belatedly, the Big Three offered smaller cars beginning with the 1960 model year. During the 1960s GM increased the number of its car platforms from three to ten; Ford, from three to eight; and AMC and Chrysler, from three each to five each. The number of distinct models sold on these platforms increased from 243 in 1950 and 244 in 1960 to 375 in 1970. The variety of models helped U.S. firms to stem the tide of foreign car sales for a few years, although it eroded their traditional "car for every purse" strategy.

The Big Three each offered a compact car for the 1960 model year: Chrysler's Plymouth Valiant, Ford's Falcon, and GM's Chevrolet Corvair. Each was about 180 inches long, 2 feet shorter than their other models, which were now termed "full-sized" or "standard." A year later GM introduced three more compact cars, called Pontiac Tempest, Oldsmobile F-85, and Buick Special. When the Corvair proved disappointing in sales and quality, GM added a fourth compact in 1963, first known as the Chevy II and later as the Nova.

Between the compact and full-sized vehicles, Ford introduced the intermediate-sized Ford Fairlane and Mercury Meteor in 1962 (Fig. 8.3). GM brought out the intermediate Chevrolet Chevelle in 1966 and repositioned the Tempest, F-85, and Special as intermediates. Chrysler moved its full-sized brand names to intermediate models and halted production of full-sized cars for several years. Most compact, intermediate, and full-sized models grew larger during the 1960s, and 90 percent had V-8 engines, so in 1971 Ford introduced the Pinto, and GM, the Chevrolet Vega—both subcompacts about 170 inches long.

In addition to the four main sizes, manufacturers sold a variety of specialty models during the 1960s. Most successful were Ford's Mustang, introduced in 1964, and GM's Chevrolet Camaro, introduced in 1967—both about the size of the compacts but much sportier. Sportier versions of intermediate cars, such as GM's Chevrolet Monte Carlo and Pontiac Grand Prix, were also popular in the late 1960s and early 1970s.

With the addition of models from European and Asian companies and expansion of the light-truck segment, the number of distinctive platforms sold in the United States increased from 30 in 1955 to 84 in 1973, 117 in 1986, and 138 in 1989. U.S. companies doubled their number of platforms from 25 to 50, Europeans increased from 5 to 30, and Asian companies increased from none to 58 during the same period.

The lid's off Comet
'63 MERCURY
COMET
For '63, Comet introduces two jaunty convertibles—one the sporty S-22 bucket-seater shown.
FLEET!
'63 MERCURY
METEOR
For '63, Meteor widens its line of low-price cars with sparkling new hardtops and wagons.
New breezeway roof
'63 MERCURY
MONTEREY
Recessed rear window opens for ventilation, stays clearer in rain or snow. Swept-back roof shades rear seat, increases headroom and rear-view visibility, adds style distinction that's Monterey's alone.
COMET · METEOR · MONTEREY. PRODUCTS OF Ford MOTOR COMPANY

8.3. Mercury, 1963. Ford Motor Company introduced three sizes of Mercury during the early 1960s, including the compact Comet, intermediate Meteor, and full-sized Monterey. Each of these three differed only cosmetically from models with Ford nameplates—a practice known as corporate twinning. (National Automotive History Collection, Detroit Public Library)

U.S. cars settled into five classes in the 1970s: full-sized or standard (about 215 inches or 5.4 meters), intermediate (200 inches or 5 meters), compact (185 inches or 4.7 meters), subcompact (170 inches or 4.3 meters), and specialty (a variety of sizes). U.S. companies built around 40–45 percent full-sized, 20–25 percent intermediate, 10–15 percent compact, 5–10 percent subcompact, and 10–15 percent specialty. The 15 percent of the market held by foreign companies in the early 1970s was almost entirely in the subcompact class.

The number of distinct models increased more rapidly than the number of platforms during the 1960s because of widespread use of "corporate twins," in which virtually identical cars were sold under two or more brands. Thus, during the 1950s the Ford Motor Company offered one Ford and one Mercury of about the same size, but with different mechanical elements and styling. By 1969, Mercury offered a subcompact, compact, intermediate, and full-sized model—but each was a twin to Ford Division products, and in some cases the two were all but indistinguishable.

Corporate twinning was even more elaborate at GM, where each of the five longstanding marketing divisions (Chevrolet, Pontiac, Oldsmobile, Buick, and Cadillac) sold a variety of sizes of models, but each had to be shared with virtually identical models sold by the other divisions. For example, GM's three new compact cars introduced in 1961—Pontiac Tempest, Oldsmobile F-85, and Buick Special—were mechanically identical, sharing chassis, transmission, and engine, although the trim and sheet metal varied. GM sold Chevrolets on six different platforms in 1970; Pontiacs, Oldsmobiles, and Buicks on four each; and Cadillacs on two. But because of corporate twinning, GM actually produced ten, not twenty, unique platforms. Some corporate twins were so similar that consumers would complain about lookalike cars.

The proliferation of models during the 1960s to some extent perpetuated GM's old policy of "a car for every purse" and purpose. The smaller cars appealed to young, first-time buyers, urban commuters, and two-car households, while the larger ones continued as the traditional car for the traditional family. But the policy of corporate twins knocked out the other pillar of GM's long-term success—the clear association of nameplates with market position. With so many products, all of which were twinned, GM was unable to maintain clear brand images for its five divisions.

For example, for decades Buick appealed to successful professionals, such as doctors, lawyers, and bankers. With the proliferation of models and corporate twins, how could GM get successful professionals to "grad-

uate" to a Buick? Before "graduating" to full-sized Buicks, should younger professionals—as in the past—be persuaded to buy lower priced, full-sized GM cars, such as Chevrolets, or should they be encouraged to begin with smaller Buicks? Should smaller Buicks be marketed primarily as commuter cars for successful professionals who turned over their full-sized Buicks to their wives, or as entry-level cars for the successful professionals' children? Or perhaps as family cars for less successful professionals who could not afford full-sized models? Meanwhile, should drivers of small Oldsmobiles be encouraged to "graduate" to large Oldsmobiles, or to small Buicks?

GM had imprinted its ladder of promotion so successfully that buyers remained loyal to specific brands long after the policy of building corporate twins made the differences insignificant. The ultimate embarrassment for GM's corporate twin policy was the "Chevymobile" scandal in the late 1970s. When the owner of a new Oldsmobile in Chicago took his car in for service, the mechanic couldn't get a replacement fan belt and oil filter to fit. The reason was that the Oldsmobile actually had a Chevrolet engine, and the Oldsmobile dealer had no reason to stock Chevrolet belts and filters. Outraged, the Oldsmobile owner complained to the consumer fraud division of the Illinois attorney general's office, stating that he had bought the car and paid an extra $175 precisely because he wanted Oldsmobile's "Rocket" engine.

GM president Pete Estes responded that because Chevrolet and Oldsmobile engines were comparable, the company had been mixing engines, transmissions, and other mechanical products for years. Seventy suits were filed around the country on behalf of other disgruntled GM customers, including suits filed by the attorneys general of all fifty states, and in 1979 GM agreed to pay each of 132,000 Oldsmobile owners a $200 indemnity and to give each of them an extended warranty on the entire powertrain of their car.[4]

The Big Three had regarded foreign cars as a minor nuisance during the 1950s. British sports cars such as MG and Triumph had style and flair, but imports—mostly European—were in general objects of ridicule, and they held a combined total of only 1 percent of the U.S. car market in 1955. Most customers were World War II veterans who had encountered them while stationed in Europe and bought them as novelty items. Reliability was abysmal—broken-down foreign cars sat for weeks until replacement parts arrived from Europe by boat—but they appealed to the expanding number of U.S. households seeking economical and dependable second cars.

Despite the Big Three's production segmentation during the 1960s, sales soared for one foreign car—the Volkswagen "Beetle." Sales increased steadily from 157,000 in 1960, to 181,000 in 1961, 223,000 in 1962, 277,000 in 1963, 306,000 in 1964, 357,000 in 1965, 420,000 in 1966, 453,000 in 1967, and 563,000 in 1968. VW sales exploded after the Doyle Dane Bernbach (DDB) advertising agency developed what proved to be the most inspired advertising campaign ever for a motor vehicle, and one of the most effective for any product. Thanks to DDB, the Beetle became the car of choice in the tumultuous 1960s for the counter-culture generation: young people on tight budgets, the handful already concerned with conservation of energy and materials, and the large cohort of youthful baby boomers whose principal automotive requirement was something their parents would find alien (Fig. 8.4). Among DDB's many clever advertisements, one featured a nearly blank page with a tiny Volkswagen in the upper left and a small title at the bottom, "Think small." Another showed a Volkswagen with a flat tire above the title, "Nobody's perfect." A third showed a Volkswagen above a large title, "Lemon."

Volkswagen doesn't do it again.
Beautiful. It's not any longer. It's not any lower. And it's not any wider. The 1969 Volkswagen. 13 improvements. Ugly as ever. Beautiful. Just beautiful.

8.4. Volkswagen, 1969. Volkswagen dominated small car sales in the United States during the 1960s by appealing to consumers' dislike of cosmetic changes to large American cars, introduced each year amid much fanfare. (National Automotive History Collection, Detroit Public Library)

Volkswagen sales hit an all-time high of 1.3 million in 1971, and in 1972 the Beetle passed the Ford Model T as the world's best-selling car ever. But like Henry Ford with the Model T in the 1920s, Volkswagen officials in the 1970s waited too long to replace the Beetle, reluctant to tinker with a quarter-century of success. The Beetle had aged out of competitiveness, and VW had nothing ready to replace it. German production and U.S. sales of the Beetle were halted in 1978. VW kept the Beetle alive in Mexico, producing 40,000 in 1995 at its Puebla assembly plant, a few of which were brought surreptitiously into the United States. Thanks to continued Mexican production, VW sold its twenty-millionth Beetle in 1981, and added another million to the total during the 1980s and 1990s.

An updated Beetle—essentially a conventional VW Golf fitted with a retro body—turned heads when it was introduced in 1997. Most customers were aging baby boomers nostalgic for their 1960s Beetle, and the decade's most prominent aging boomer, President Bill Clinton, bought one for his daughter—apparently the first time that a sitting U.S. president had bought a foreign car.

Ford had figured out how to sell American families their first car back in the 1910s, and GM had figured out how to sell Americans replacements for their family cars beginning in the 1920s. By 1930, 60 percent of U.S. households had a car. The percentage declined during the 1930s and 1940s because of the Great Depression and World War II, but the task of getting nearly every family a car resumed after the war. The percentage of U.S. households owning a car increased from 54 percent in 1948 to 60 percent in 1950, 65 percent in 1951, 70 percent in 1954, 80 percent in 1969, and 90 percent in 1990.

As the upward climb in the percentage of households with a car inevitably ended, car makers could still sustain some growth by selling households their first vehicles or replacements, because the number of households increased much more rapidly than the number of people. Beyond the growth of households, manufacturers had to find new ways to sell vehicles—and they did. The number of vehicles in the United States, which had stagnated at about 30 million between 1930 and 1945, exceeded 40 million in 1948, 50 million in 1950, 60 million in 1955, 70 million in 1960, 100 million in 1970, and 200 million in 2000. In the 1950s the United States had about 45 million households and 50 million vehicles. By 2000 the number of households doubled to 110 million, while the number of vehicles quadrupled to 200 million. Most of the growth in vehicle sales in the second

half of the twentieth century came from supplying families with more than one vehicle.

As long as most households had precisely one vehicle, the Big Three could maintain their traditional marketing strategy of building essentially similar-sized vehicles distinguished by social class through price. But the typical American family now owned more than one car: Mom hauled around kids and groceries in the family car, while Dad commuted to work in the second car, and the oldest child took the third car to high school. These second and third cars could be smaller than the traditional, full-sized family cars because only one or two people were ever likely to be in them. When the energy crisis pushed Americans into smaller family cars in the 1970s, Detroit's traditional, large family cars died, and with them the class-based system for distinguishing among them.

Downsizing in the 1970s

Ford ran this advertisement in 1977:

> For 1977 some car makers will offer you only shorter, narrower, lighter full-size cars. Ford has a better idea. Choice:
>
> —Ford LTD. The full-size car that kept its size.
>
> —And the new trimmer, sportier LTD II
>
> This year some car makers are making their full-size cars smaller. But Ford believes that people who want the traditional full-size car they're used to should have that choice. So the 1977 Ford LTD hasn't been reduced by a single inch!

A table in the advertisement showed that the 1977 Ford LTD still had the same 121-inch wheelbase as in 1976—no surprise, since the car had not been redesigned—while Chevrolet's Caprice and Impala wheelbase had been reduced from 121.5 inches in 1976 to 116 inches in 1977, shorter even than the 118-inch 1977 Ford LTD II. The advertisement did not state that the principal "new" element of the LTD II was its name; it was otherwise a cosmetic remake of Ford's old mid-sized Torino.

Ford may have advertised "a better idea," but U.S. consumers did not agree. Sales increased 68 percent between 1976 and 1977 for the full-sized Chevrolet, compared to less than 10 percent for the Ford LTD and LTD II. While GM spent the money to downsize its full-size models quickly, Ford—unable to match GM's deep pockets—was forced to sell older models with new names. Ford advertised "choice," but GM advertised the fuel-

efficiency ratings of its 1977 full-sized cars: 21 mpg for highway driving and 16 mpg in the city.

The motor vehicle and petroleum industries flourished together through most of the twentieth century: cheap and abundant petroleum was essential for selling motor vehicles, and rising demand for motor vehicles was essential for exploiting oil fields. The rapid growth in demand for petroleum to power motor vehicles in the first years of the twentieth century coincided with discovery of large, easily exploited fields in Texas. With petroleum abundant and cheap, U.S. manufacturers had no incentive to build fuel-efficient models. The inexpensive, lightweight Ford Model T, which held nearly half the U.S. market during the 1910s, achieved less than 20 mpg, and the larger, heavier vehicles that held the other half of the market were even less efficient. Average fuel efficiency for all U.S. vehicles was only 15 mpg in 1930 and 12 mpg in 1975.[5]

The United States became a net importer of petroleum in 1947. The handful of large, transnational companies then in control of international petroleum distribution calculated that extracting domestic petroleum was more expensive than importing it from the Middle East. Western companies set oil prices and paid the Middle Eastern governments only a small percentage of their oil profits. U.S. petroleum imports increased from 14 percent of total consumption in 1954 to 40 percent in 1970.

Four Middle East countries possessing substantial petroleum reserves—Iran, Iraq, Kuwait, and Saudi Arabia—plus Venezuela created the Organization of Petroleum Exporting Countries (OPEC) in 1960. Joining later were four other Middle East states—Algeria, Libya, Qatar, and United Arab Emirates—plus Indonesia, Gabon, Nigeria, and Ecuador (which withdrew in 1993). Foreign-owned petroleum fields were either nationalized or more tightly controlled, and prices were set by governments rather than by petroleum companies.

OPEC's Middle East members were angry with North American and Western European countries for supporting Israel during that country's 1973 war against its neighbors. After repeated failures to defeat Israel on the battlefield, OPEC ministers decided to retaliate in a different way: by refusing to ship petroleum to Israel's allies, notably the United States. The OPEC boycott reduced the world supply of petroleum by only 5–7 percent, less than the shortage caused by disruption during wars in the Middle East in 1956 and 1967.[6] But oil companies sharply reduced their refining of petroleum, allegedly to raise profits, which had dropped after the U.S. government's imposition of controls on crude oil prices in 1971.

U.S. motorists panicked as gasoline supplies dwindled during the winter of 1973–74. Each U.S. gasoline station received a small quantity of fuel, which ran out early in the day. Long lines formed at gas stations, and some motorists waited all night for fuel. Gasoline was rationed by license plate number (cars with licenses ending in an odd number could buy only on odd-numbered days). All stations were closed on Sundays. Topping off the tank was prohibited, so before pumping, attendants verified that the fuel gauge read at least half empty. European countries took more drastic action: the Netherlands, for example, banned all but emergency motor vehicle travel on Sundays.

The boycott inconvenienced U.S. consumers and businesses, but it hit OPEC countries even harder because they were not selling their principal economic asset. OPEC lifted the boycott in April 1974 and instead repeatedly raised the price of petroleum. Prices at U.S. gas pumps for a gallon of regular rose from an average of 39¢ in 1973 to $1.41 in 1981. To import oil, U.S. consumers spent $3 billion in 1970, $42 billion in 1978, $60 billion in 1979, and $80 billion in 1980.

The rapid escalation in petroleum prices caused severe economic problems in the United States and other developed countries during the 1970s. Production of motor vehicles, as well as steel and other energy-dependent industries, plummeted in the United States in the wake of the 1973–74 boycott and never regained preboycott levels. Many manufacturers were forced out of business by soaring energy costs, and the survivors were forced to restructure their operations to regain international competitiveness.

The United States reacted by passing the Energy Policy and Conservation Act in 1975. The act set three policies with regard to petroleum. First, the United States reduced its dependency on petroleum imported from Persian Gulf states other than Saudi Arabia, and instead imported more petroleum from Mexico and Venezuela. Mexico, Saudi Arabia, and Venezuela accounted for about one-fourth of total U.S. consumption and about one-half of total U.S. imports in 1995, compared to about one-tenth of consumption and about one-fourth of imports in 1973.

The second U.S. policy was to create a Strategic Petroleum Reserve, several months' supply of petroleum stored in caverns along the Louisiana and Texas coast. If U.S. petroleum supplies should suddenly drop, the president of the United States could order release of a portion of the Strategic Petroleum Reserve in order to prevent a rapid price rise or other economic disruptions. The amount of petroleum in the strategic reserve increased from 39 million barrels in 1980 to 180 million in 1985, before leveling out

during the 1990s at about 215 million barrels, equivalent to 10 weeks' consumption of imported oil.

The third policy was to encourage more efficient use of petroleum. A major component of this policy was to require manufacturers to build more efficient vehicles. All manufacturers selling more than 10,000 cars a year in the United States had to meet a corporate average fuel efficiency (CAFE) standard set by the U.S. Department of Transportation. The fuel efficiency for a company's fleet of vehicles was calculated by identifying the annual sales for each of the company's models, multiplying each model's sales by its fuel efficiency, summing the products, and dividing by total company sales. Thus, if a company sold two models, including 500,000 of one model that achieved 20 mpg and 1.5 million of a second model that achieved 30 mpg, then the company's overall fuel efficiency rating would be 27.5 mpg, calculated as follows:

((500,000 x 20 mpg) + (1,500,000 x 30 mpg)) / 2,000,000 = 27.5 mpg

The first CAFE standard, issued in 1975, required manufacturers to achieve a fleet average of 18 mpg for 1978 model cars. The standard increased to 20 mpg in 1980 and 27.5 mpg in 1985. A company failing to achieve the CAFE would be fined $2 for each one-tenth of a mile above the mandated level multiplied by the total number of vehicles the company sold that year in the United States.

Manufacturers initially opposed CAFE, fearing that they could meet the mandated standards only by selling unprofitable small cars. GM, for example, claimed that subcompact Chevettes would have to make up 92 percent of its sales to meet CAFE during the 1970s. But manufacturers did not want to be fined, fearing adverse political fallout and negative public image for failing to meet the CAFE standard. Manufacturers also determined that they could be vulnerable to lawsuits by shareholders for knowingly violating a federal law.[7] For all these reasons, they redesigned their cars to meet CAFE standards.

As a result, the average fuel efficiency of cars sold in the United States increased rapidly during the late 1970s and early 1980s, from 15.8 mpg in 1975 to 17.5 mpg in 1976, 18.3 in 1977, 19.9 in 1978, 20.3 in 1980, 25.1 in 1981, and 26.0 in 1982. CAFE standards were met in part when Congress reduced the national speed limit to 55 mph and withheld federal highway funds from states that refused to adopt and enforce the lower limit, because vehicles get higher mpg rates at that speed than at higher speeds. As author

and native Texan Molly Ivins said, the 55 mph speed limit relocated every city in Texas one hour farther away from each other.

Fuel efficiency was also promoted by reducing component weight, aerodynamic drag, and operating inefficiencies. For example, front-wheel-drive transaxles, which eliminated the driveshaft from the transmission to the rear differential, saved 300 pounds. Plastic and aluminum were substituted for steel in the bumpers, hood, and body panels. Installing radial tires reduced fuel consumption by 3 percent, and including a small spare tire saved weight. Improved lubricants and bearings reduced friction, and microprocessors helped the engine run at peak efficiency. By designing smaller, sleeker front ends, manufacturers added another 10 percent to fuel savings.

Because of the costs of downsizing, Ford posted record losses in the late 1970s, and Chrysler almost went bankrupt, but in the long run downsizing did more harm to GM. The company survived downsizing in the 1970s with the belief that adjusting to changing consumer preferences was a minor problem that could be easily accomplished with a nip here and tuck there. Ford and Chrysler had to radically restructure, and they emerged in the 1990s stronger than ever. Having lost the opportunity to restructure in the late 1970s and early 1980s, GM had to live through the end of the twentieth century with outdated products and bloated hourly and salaried work forces.

Downsizing led to confusion and compression. Consumers were confused because not all cars were downsized at the same time. For several years manufacturers sold a mix of recently downsized models and older designs. In any given year, one company's compacts could be larger than another company's intermediates—or even its own intermediates. Even after all cars had been downsized, consumer confusion continued because manufacturers, seeking competitive advantage, no longer conformed to the same size classification.

Volkswagen, the dominant small-car seller in the United States at the start of the energy crisis, suffered an even sharper sales decline than did U.S. companies. From an all-time high of 569,000 in 1970, U.S. sales of VW cars plunged to 202,000 in 1976 and 159,000 in 1982. Americans turned instead to Japanese-produced cars during the 1970s. Toyota's U.S. car sales increased from 231,000 in 1974 to 582,000 in 1980; Nissan's, from 185,000 to 517,000; and Honda's, from 42,000 to 375,000 (Fig. 8.5). Meanwhile, Big Three car sales declined from 7 million to 6.4 million during the six-year period.

8.5. Toyota, 1974. Japanese car makers substantially increased market share in the United States during the 1970s by offering smaller, gas-efficient vehicles. (National Automotive History Collection, Detroit Public Library)

Quality Gap in the 1980s

Americans bought their first Japanese cars during the 1970s because they got better gas mileage. They bought their second Japanese cars during the 1980s because they were built better. The U.S. auto industry remained in denial through the 1980s about the quality gap between domestic and Japanese cars: enthusiast magazines were biased in favor of foreign novelties, *Consumer Reports* was run by Nader-inspired safety freaks, J. D. Power surveys were unscientific (even though when his company first reported a quality gap, Mr. Power himself was driving a low-rated Oldsmobile).

An especially vocal and influential critic of the quality of U.S.–made vehicles was *Consumer Reports,* the monthly magazine published by Consumers Union (CU), a nonprofit organization established in 1936 to test consumer products scientifically. Consumers Union refused advertising in the magazine, unsolicited products or gifts from corporations, corporate underwriting of studies, or permission for a company to publicize a favorable rating. *Consumer Reports* collected information about motor vehicles from two main sources. First, the organization tested vehicles for several dozen performance factors. Because CU couldn't afford to buy many new cars in its early days, the first head of the Auto Test Division (1936–66), Lawrence Crooks, a wealthy car enthusiast, bought many of them himself or borrowed them from friends. Later, CU sent staff members to purchase vehicles anonymously from ordinary dealers. CU began testing at a track it purchased in East Haddam, Connecticut, in 1986. The second rating method that CU used was responses to questionnaires returned each year by its readers. CU constructed frequency-of-repair tables for vehicles, beginning in 1952, based on reader responses. For each model, a table displayed records for the most recent years along the horizontal axis and the repair records for major operating systems such as engine and transmission along the vertical axis. CU's frequency-of-repair tables revealed dramatic differences between Japanese-made and American-made products in the 1970s.

The other influential reviewer of vehicle quality in the United States, beginning in the 1980s, was the firm of J. D. Power and Associates. J. David Power III had worked for Ford as a financial analyst before deciding to try consumer research. He began with a contract to do market research for Toyota.

Power and Associates made money on surveys in two principal ways. First, the firm sold car makers book-length proprietary reports that compared factories, models, and subsystems such as brakes and transmissions in far more detail than the results released to the public. In this way, car makers could identify exactly what component or factory was responsible for a high or low score. Power and Associates generated $50 million in revenue in 1997 from selling detailed information to thirty auto industry clients. Second, the firm sold licenses at fees of up to $250,000 permitting car makers to advertise high Power ratings. Only a vehicle that scored at the top of a list could be so advertised, but Power and Associates created a large number of lists from the scores, such as best subcompact, best near luxury car, and so forth. In this way, multiple vehicles each year could advertise as having the highest rating.

Power and Associates conducted several surveys for each model year. Most influential was the Initial Quality Survey (IQS), begun in 1987, in which tens of thousands of new vehicle buyers were asked to assess their experience after ninety days of ownership. For example, in 1997, 43,000 recent purchasers of 1997 models were asked questions concerning 89 problem areas. Results were compiled as number of problems per 100 vehicles, so that the lower the score, the fewer the problems. Power and Associates initially released scores only for better-than-average makes and models, but as interest in the results grew, the firm released all results—especially after newspapers leaked the scores of the poorly rated brands.

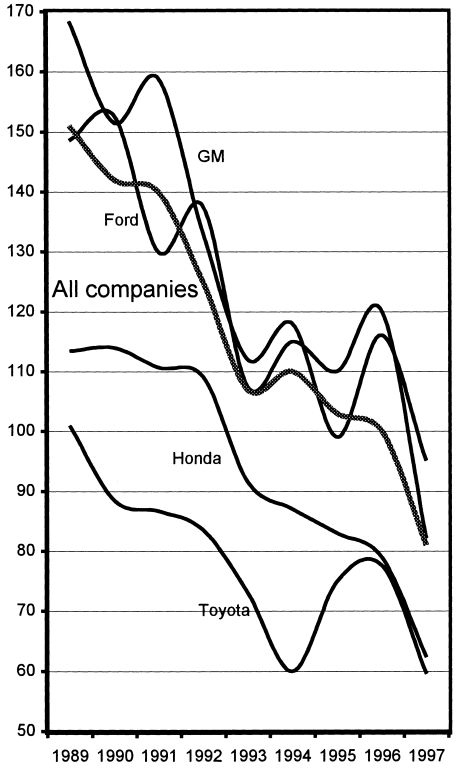
The first IQS in 1987 revealed a substantial quality gap between Japanese-made cars and others. Average scores were 143 problems per 100 vehicles for Japanese cars, 175 for American, and 192 for European. Over the next decade, scores of all vehicles improved dramatically; in 1997 the average IQS score had declined to 65 for Japanese cars, 86 for American, and 95 for European. The gap between Japanese and American products narrowed but did not disappear (Fig. 8.6).

Faced with a problem—that all vehicles had improved dramatically in quality during the 1990s—Power and Associates expanded its survey in 1998 from 89 questions to 1,235. The additional questions enabled the company to determine consumer satisfaction with new technologies and such features as antilock brakes, airbags, navigation systems, and cupholders, as well as to pinpoint more precisely the cause of complaints. Changing the questionnaire also made it impossible to track long-term changes.

Aside from its prominence for consumers, the Power and Associates surveys were especially influential because studies conducted by U.S. car makers themselves confirmed the findings: the quality gap between U.S. products and Toyota narrowed during the 1990s but never disappeared. And even if the quality of American-made cars was nearly as good, why should consumers abandon Japanese cars? After two decades of satisfaction with their Japanese cars, consumers needed a much stronger inducement to switch back to American products.

Trucks in the 1990s

With the quality gap narrowed, and styling of cars roughly comparable, American consumers searched for distinctive, affordable alternatives that could express and reflect highly personal preferences. The solution was to buy a truck. Light trucks, which had consistently held about a 10 percent



8.6. J.D. Power Initial Quality Survey Ratings. The quality of all cars improved sharply during the 1990s, and differences between brands narrowed. Power changed its method of calculating the rating in the late 1990s, making comparisons with earlier time periods impossible. (Adapted by the author from multiple sources)

share of the overall U.S. vehicle market between the 1910s and 1960s, exceeded 20 percent of the market in 1974, 30 percent in 1987, and 40 percent in 1994. The Big Three U.S.–owned companies—Chrysler, Ford, and General Motors—sold more light trucks than cars for the first time in 1997.

The most popular truck for most of the twentieth century was the full-sized pickup, useful for farmers and other businesses. Truck sales increased during the late twentieth century because Americans with no intention of using them for business were attracted to new products, especially compact pickups during the 1970s, minvans during the 1980s, and sport utility vehicles during the 1990s.

Full-Sized Pickups

Full-sized pickups appealed to two very different groups. Rural residents wanted a tough, sturdy frame, four-wheel drive, and enough headroom to wear a cowboy hat. Suburban commuters wanted reliable winter transportation, rapid acceleration, luxury interiors, and air conditioning. Both sets

of consumers demanded a gas-guzzling engine powerful enough to carry a heavy load or pull a trailer. The Big Three dominated the market for full-sized pickups in part because they were the only ones offering affordable V-8 engines to Americans nostalgic for massive pre–energy crisis vehicles.

The dominance of the Big Three was also a legacy of the 1964 "chicken tax." The United States in 1962 accused the European Community of unfairly restricting imports of U.S. poultry, allegedly at the request of West German chicken farmers. In retaliation, the United States imposed a 25 percent tax on all imported light trucks. Light trucks were selected because the dollar value of imports was about the same as the revenues lost from not exporting chickens, and a German firm (Volkswagen) accounted for more than 90 percent of the 40,000 trucks then imported to the United States. The tax on SUVs and minivans was reduced to 2.5 percent in 1989, on the grounds that they were not really trucks, but the 25 percent tax remained for full-sized pickups.

Compact Pickups

Compact pickups entered the market during the 1970s in the wake of the energy crisis, because they got about 25 mpg, compared to 15 mpg for full-sized pickups. Though they were a foot shorter and a ton lighter than full-sized pickups, compact pickups proved large enough for many businesses.

Younger buyers on a limited budget were attracted to compact pickups by low prices and insurance rates. For about the same price as a subcompact car, the compact pickup offered more versatility and customizing possibilities. Its spartan passenger compartment could accommodate only one passenger besides the driver, but a compact pickup had a rear bed able to carry more groceries and pets than a subcompact car's cramped rear seat or trunk, and was weatherproof when fitted with a cab.

The annual market for compact pickups in the United States rose during the 1970s and 1980s to about 1 million. Sales stagnated at the 1 million level during the 1990s, but producers continued to invest in the segment primarily as insurance against the next downturn in demand for larger, gas-guzzling trucks. Because they had more experience building small vehicles, Japanese companies were able to capture a larger share of the market for compact pickups than for the other types of trucks.

Minivans

Faced with the likelihood of bankruptcy following the energy crisis of the 1970s, Chrysler appealed to the federal government for financial assis-

tance. The Chrysler Loan Guarantee Act of 1979 created a board authorized to issue up to $1.5 billion in loan guarantees to Chrysler over a two-year period. Loans were secured by Chrysler's assets, valued by the government at $2.5 billion if liquidated. The board issued the first $550 million in June 1980, six months after passage of the act, and ultimately provided Chrysler with $1.2 billion in guarantees.

Chrysler generated enough revenues to repay the first $400 million of its government-guaranteed loans on June 15, 1983, the first day it could legally do so. Chrysler nearly doubled sales between 1980 and 1985, from 1 million to 1.9 million vehicles, primarily by developing a new platform, which the company called the "K" car and sold under a wide variety of names. The most innovative version, sold beginning in the 1984 model year under the names Plymouth Voyager and Dodge Caravan, was dubbed a "minivan" (Fig. 8.7). Ford, GM, and several Japanese companies quickly introduced minivans, but Chrysler retained the largest market share, because competitors used truck platforms that were less nimble and comfortable than the Chrysler minivans based on the "K" car.

The minivan grew in popularity primarily as a substitute for the station wagon, which had been the car of choice for large suburban families during the 1950s and 1960s. The peak year for station wagons was 1957, when they captured 15 percent of the market. The height of suburban chic was ownership of a top-of-the line station wagon, such as the Chrysler Town and Country or Ford Country Squire, decorated with wood side panels.

Station wagon sales declined from 1.1 million in 1979 to 300,000 (only 3 percent of the market) in 1989. With its high roof and short hood, the minivan offered more space for hauling people and goods in a smaller, more fuel-efficient package than a station wagon. The minivan replaced the station wagon as the vehicle of choice for the suburban housewife who spent the day transporting her own and her neighbors' children to and from school, sports, and other activities. Minivan drivers became known as "soccer moms," in recognition of the country's fastest growing school-age sport.

Minivan sales stagnated at about 1.2 million during the 1990s. Though respected for their versatility and usefulness—and recommended by "sensible" publications like *Consumer Reports*—minivans were unloved, boring, and pallid, especially compared to the types of trucks introduced in the 1990s. The only notable attempt at a provocative minivan design—made by GM in the early 1990s—failed because its sharply angled front end looked like a Dustbuster vacuum cleaner.

8.7. Dodge Caravan, 1987. Chrysler Corporation, having recovered from near bankruptcy, featured its president Lee Iacocca in advertisements for minivans. (National Automotive History Collection, Detroit Public Library)

Sport Utility Vehicles

Sport utility vehicles (SUVs) were sold in three basic sizes during the 1990s—large, medium, and small. Sales of all three sizes grew rapidly across the decade.

Small SUVs originated with the Jeep during World War II. In 1940 the U.S. Army asked 135 manufacturers to submit proposals for a quarter-ton reconnaissance vehicle. A prototype had to be ready in forty-five days. The

only company that met the deadline was American Bantam Car Company, which had started in 1929 as the American Austin Company, gone bankrupt in 1934 after making fewer than 15,000 cars, and been resuscitated under the Bantam name in 1936.

Over Bantam's protests, the army shared the blueprints for the recon vehicle with Willys-Overland Motors and Ford, and ordered 1,500 each from the three companies. The army judged the Willys version to be the best and awarded it the principal contract. Willys-Overland had been the second-leading car maker behind Ford during the 1910s and had hit an all-time peak of 315,000 in 1928, before sales plummeted during the 1930s, to a low of 6,000 in 1932.

When Willys could not produce enough recon vehicles, the army asked Ford to build them as well, using the Willys model. Ford called the model a "general purpose vehicle," or GP for short, from which the Jeep name probably derived. Willys-Overland built 362,841 of the vehicles, and Ford, 281,448; American Bantam, which had developed the prototype, built only 2,675, and went out of business before the end of the war.[8]

The rugged and adaptable Jeep performed a wide variety of tasks during World War II, doing all of them well. Bill Mauldin, America's most prominent wartime editorial cartoonist, captured the attitude of many soldiers toward the Jeep, when he drew a cartoon of a tearful sergeant, his eyes shielded, shooting his broken-down Jeep, which was lying mortally wounded in a ditch.

Control of Jeep production for civilian purchase passed through a half-dozen corporations during the second half of the twentieth century. Willys-Overland, holding the trademark on the Jeep name, produced several thousand civilian Jeeps in the late 1940s and early 1950s. Kaiser-Frazer Corporation purchased Willys-Overland in 1953, renamed it Kaiser Jeep in 1963, and sold it to American Motors in 1969. Renault acquired controlling interest in AMC in 1980 and sold it in 1987 to Chrysler, which in turn was acquired by Daimler-Benz in 1998. At each sale, Jeep was a major attraction for the acquiring company.

The Jeep Wrangler, successor to the GP vehicle, remained an exotic oddity until the 1990s. In that decade the segment grew from 30,000 to 300,000, when several companies, including Toyota and Honda, introduced small SUVs derived from car platforms.

General Motors had introduced a large SUV back in 1936, named the Suburban, for use as a small bus. Annual sales of large SUVs remained very

small until they soared during the 1990s from 60,000 to 600,000. By offering a luxuriously appointed, large SUV, Lincoln passed Cadillac as the best-selling luxury nameplate in the United States for the first time in 1998. These 4-ton behemoths were equipped with 5-liter, V-8 engines, suitable for towing boats and motor homes.

The gap in the market between the large and small SUVs was filled by compact sport utility vehicles. SUVs derived from compact pickups, such as Ford Bronco, GM Blazer, and Jeep Cherokee, reached 500,000 annual sales during the 1980s. The segment grew to 1.6 million vehicles during the 1990s, following development of newly engineered products, led by Ford Explorer and Jeep Grand Cherokee, that were more comfortable than the earlier, truck-based versions.

Appeal of Trucks

Truck sales soared during the 1990s, because producers liked selling them and consumers liked buying them. For manufacturers, the principal attraction of selling more light trucks was simple: higher profit. In 1999 DaimlerChrysler grossed $8,000 on its Dodge Durango full-sized SUV and $9,000 on its Jeep Grand Cherokee compact SUV; Ford, $12,000 on its Expedition and $15,000 on its Lincoln Navigator full-sized SUVs.[9] In contrast, DCX grossed only $2,500 on its Neon subcompact car, and Ford, $2,100 on its Escort subcompact car; both netted losses after allocating corporatewide overhead.

Compare Ford's best-selling Taurus car and full-sized pickup truck. The average Taurus cost Ford about $14,595 to make in 1998 and carried a manufacturer's suggested retail price of $18,995, for a profit of $4,400. After adding several thousand dollars of overhead to cover the costs of design, factory tooling, and administration, the Taurus was only slightly profitable for Ford, and provided a low rate of return on investment. Ford's full-sized Super Duty pickup truck cost $15,315 to manufacture—only $720 more than the Taurus—but carried a suggested retail price of $24,015, $5,020 more than the Taurus. Ford made an average profit of $8,700 on the Super Duty before overhead, and even after overhead the company had a handsome rate of return on investment, about 30 percent.

Selling more light trucks also helped manufacturers meet CAFE standards. When CAFE was created in the 1970s, farmers, home builders, and other small businesses urged lower standards for trucks, arguing that less powerful, more fuel-efficient trucks would impose hardships on them.

Energy savings would evaporate, they claimed, if businesses were forced to make more trips hauling heavy materials in smaller, less powerful trucks. Consequently, the Department of Transportation set CAFE in 1979 at 17.2 mpg for two-wheel-drive trucks and 15.8 mpg for four-wheel-drive trucks, compared to 18 mpg for cars. The distinction between two- and four-wheel-drive trucks was dropped in 1992, when CAFE for all light trucks was set at 20.2 mpg. The light-truck standard increased to 20.4 mpg in 1993, 20.5 in 1994, 20.6 in 1995, and 20.7 in 1996, when Congress barred further increases.[10] But with the CAFE for cars frozen at 27.5 mpg, the difference in standards between cars and trucks of nearly 7 mpg was much greater in 2000 than when CAFE was established a quarter-century earlier.

The classification of a vehicle as a truck or a car for CAFE purposes was supposed to be determined through a complex set of measurements, including at least four of the following: approach angle of not less than 28 degrees, breakover angle of not less than 14 degrees, departure angle of not less than 20 degrees, running clearance of not less than 20 centimeters, front and rear axle clearances of not less than 18 centimeters each. In reality the government made the determination on an ad-hoc, case-by-case basis. Chrysler's minivan was classified as a truck in 1984 even though it was built on a car chassis and was marketed primarily as an alternative to a station wagon. Chrysler did not want the minivan classified as a car, because it then would have failed to meet the CAFE fleet standard for cars. Regulators justified the truck designation because some minivans were bought by businesses to haul cargo.

To meet even the lower CAFE standard for light trucks, manufacturers took advantage of several legal loopholes. To stimulate higher demand for corn, farmers and processors of corn got Congress to insert a loophole in the fuel economy law in 1988 that exempted companies from fines if they sold any vehicles powered by ethanol made from corn. Chrysler missed the CAFE truck standard in each of the last four years before its 1998 takeover by Daimler-Benz, but the company was never fined, because it sold a handful of ethanol-powered minivans. A manufacturer could also avoid fines in a year it failed to meet CAFE, by transferring credits from a year in which its fleet average exceeded the minimum. These credits could be juggled backward and forward for as many as three years.[11] A manufacturer could also manipulate a year's fleet average by arbitrarily determining when a model year began and ended.

Few Americans cared that trucks got low fuel mileage, because petro-

leum prices remained low. In the United States a gallon of regular gas, which had cost $1.42 in 1981 ($2.62 accounting for inflation) declined to 95¢ in 1999. World prices for petroleum plummeted from over $30 per barrel in 1980 to around $10 per barrel during most of the 1980s and 1990s. With the increasing popularity of light trucks, the petroleum conservation measures introduced in the United States in the 1970s eroded. U.S. petroleum usage declined from 7.0 million to 6.5 million barrels per day between 1970 and 1982, but then increased to 7.8 million barrels per day in 1995.

When the Sierra Club ran an article in its magazine in 1998 criticizing the poor fuel economy of trucks, vehicle manufacturers withdrew their advertisements from the magazine, and the organization's advertising revenues dropped 7 percent that year. Truck advertisements had been placed in the magazine because a large percentage of the Sierra Club's otherwise environmentally sensitive members drove large trucks. Sierra Club members, many of whom lived in the western United States, claimed that they needed large, comfortable vehicles to drive long distances and trucks to travel on rough roads.[12] The Sierra Club may have fostered a backlash against trucks intellectually but not in the marketplace.

Consumers liked light trucks, because they felt safer riding in them. Four-wheel drive gave them better traction in snow and ice, and the taller suspension raised them several inches above cars, giving them an overview of traffic conditions. In a crash between a heavier truck and a lighter car, the heavier vehicle suffered less damage, and the passengers in it were more likely to survive. In recognition of this reality, State Farm Insurance Company, the largest vehicle insurer in the United States, set lower collision insurance rates for light trucks than for cars beginning in 2000. On the other hand, light trucks were much more likely than cars to be involved in one-vehicle accidents, because they offered inferior road handling and had a greater tendency to roll over.[13] Although cars were cheaper, accelerated faster, and got better gas mileage, they were simply out of fashion for many Americans in 2000. Sales of Ford's Explorer sport utility vehicle barely suffered following reports in 2000 that most of the fatalities resulting from tread separation of Firestone tires had occurred in Explorers, even after investigations were begun to determine if the design of the vehicle was partly to blame. Given the conflict between attractive styling and inferior performance, manufacturers struggled to design crossover vehicles that looked like trucks but handled like cars.

Electric Vehicles in the Twenty-first Century

In 1900 the electric car was rare and exotic. In 2000 that was still the case. The difference was that in 1900 the United States contained fewer than 5,000 motor vehicles, so any vehicle, regardless of power source, was rare and exotic, while in 2000 the United States had more than 200 million gasoline-powered vehicles and only a handful of electric-powered cars. Through the twentieth century the electric car remained the "car of the future," a remote and distant future. The future for the electric car drew closer early in the twenty-first century, but how much closer?

Of the 4,000 cars sold in the United States in 1900, only 22 percent had gasoline engines, compared to 38 percent with electric power, and 40 percent powered by steam. The electric-powered Columbia was the best-selling model in the United States in 1899 and again in 1900, when it became the first car ever to exceed 1,000 in annual sales. The early electric car played an especially important role in initiating women to motoring. Few women were interested in driving a noisy, dirty, and hard-to-start, gasoline-powered car, but an electric car was silent, clean, and easy to start. Electric vehicles were especially popular in the big cities of the Northeast. Their relative quietness and cleanliness made them popular as taxicabs in New York.

The main shortcoming plaguing the electric car in 1900 remained unchanged a century later—its limited range between recharges. An electric car in 1900 had to be recharged every 20 miles or so for two or three hours, not much different than in 2000. Recharging facilities were scarce in 1900, as in 2000, especially in rural areas, although a network of six recharging stations made it possible to drive between New York and Philadelphia. Adding to the obstacles, electricity was much more expensive in 1900 than in 2000. Each recharge cost $15 in 1900 (equivalent to $330 in 2000), and operating costs were figured at about 3¢ per mile, compared to 1¢ per mile for steam- and gasoline-powered vehicles. Cheaper and more powerful gasoline engines quickly dominated the U.S. market.

The impetus for less polluting vehicles at the turn of the twenty-first century came from the California Air Resources Board (CARB), which had begun mandating pollution reduction strategies during the 1960s. California's population grew from 1.5 million to 15.7 million between 1900 and 1960, while the population of the city of Los Angeles increased from 100,000 to 2.5 million. On sunny, windless days, Angelenos began to notice a brown haze hanging over the city that stung the eyes and caused res-

piratory problems. They called the haze *smog,* a blend of the words *smoke* and *fog*. Smog caused an average of 250 unhealthy days a year and 150 very unhealthy days in Los Angeles during the 1970s.

Photochemical smog formed when hydrocarbons and nitrogen oxides from motor vehicles mixed with sunlight. For each pound of fuel burned in a car, 0.2 pounds of nitrogen oxides and 0.1 pounds of hydrocarbons were discharged. Motor vehicles accounted for 50 percent of nitrogen oxides and 60 percent of hydrocarbons emitted into the air nationally during the 1960s, and for higher percentages in Los Angeles. Cars built in the United States after World War II generated much more nitrogen oxides than prewar models, because they had more powerful, higher compression engines that ran hotter. The hotter oxygen and nitrogen in the cylinder air reacted to form nitrogen oxides, which were emitted through the exhaust pipe into the air.

In addition to nitrogen oxides and hydrocarbons, motor vehicle emissions in the 1950s and 1960s also generated large amounts of a third major pollutant, carbon monoxide. One pound of burned fuel generated 0.5 pounds of carbon monoxide, and motor vehicles were responsible for 69 percent of the national total level of carbon monoxide. Breathing carbon monoxide could reduce the oxygen level in blood, impair vision and alertness, and threaten those with breathing problems.

In 1961 the California Motor Vehicle Pollution Board (renamed California Air Resources Board in 1968) placed the first emission controls on motor vehicles, requiring that all vehicles sold in the state beginning in 1963 be equipped with crankcase blowby devices. Vehicles sold in California in 1966 were required to have exhaust-control systems that reduced hydrocarbons and carbon monoxide.

The most important federal initiative to control the three major polluters was the 1970 Clean Air Act, which called for the U.S. Environmental Protection Agency (EPA) to issue national air quality standards and specify required emission reductions. A year later the EPA called for 90 percent cuts in emissions for carbon monoxide and hydrocarbons by 1975 and for nitrogen oxides by 1976. Goals were later pushed back to 1981.

When the Clean Air Act was signed, the technology to meet the standards did not exist, and a 1969 Emissions Consent Decree forbade GM, Ford, and Chrysler from sharing research and development on emissions technology.[14] Ford and Chrysler wanted to meet the standards by designing cleaner-burning engines. But powerful GM, which at the time still controlled nearly half the U.S. market, preferred catalytic converters and lead-

free gasoline instead. The catalytic converter had the advantage of attaching the new technology to an existing engine. To meet emissions standards, manufacturers installed catalytic converters on cars sold in California in 1975, and in the rest of the country two years later.

Nitrogen oxide and hydrocarbon emissions in the United States declined by more than 95 percent between 1970 and 2000, and carbon monoxide emissions decreased by more than 75 percent.[15] Most of the gains came between the mid-1980s and mid-1990s, once older vehicles without catalytic converters were off the roads.

The catalytic converter addressed one environmental problem—smog—but unintentionally contributed to another—global warming. The average temperature of Earth's surface increased by 1 degree Celsius (2 degrees Fahrenheit) during the twentieth century compared to the nineteenth. The two warmest years of the century were 1999 and 1998. The increase may have been a random variation, but most scientists considered it evidence of global warming. If so, a major contributor to global warming was the burning of petroleum in motor vehicles.

Earth is warmed by sunlight that passes through the atmosphere, strikes the surface, and is converted to heat. Because some of the heat is trapped in Earth's atmosphere, while some passes back through the atmosphere to space, the planet has moderate temperatures that sustain flourishing plant and animal life. Some of the heat heading for space can be blocked or delayed by a concentration of trace gases in the atmosphere, thereby raising the temperature of Earth. The twentieth century recorded increasing levels of two trace gases: carbon dioxide and nitrous oxide. Contributing to the growth of the two trace gases was the use of catalytic converters, which rearranged nitrogen-oxygen compounds to form carbon dioxide and nitrous oxide (laughing gas). As with petroleum depletion, pollution emissions were exacerbated by the rapid growth in sale of trucks. Large sport utility vehicles emitted about twice as much carbon dioxide and nitrogen oxides as passenger cars.

In 1990 CARB ordered that 2 percent of the vehicles sold in California in 1998 had to achieve not simply lower emissions, but zero emissions. Each manufacturer selling at least 10,000 vehicles annually in California was obligated to meet the 2 percent standard, or else be prohibited from selling any vehicles in the state. Thus, if Honda sold 160,000 vehicles in California in 1998, it would be required to sell 3,200 zero-emissions vehicles. Zero-emissions vehicles had to account for 5 percent of each company's sales in 2000 and 10 percent in 2003.

The Ozone Transport Commission (OTC), established by Congress in 1990 to develop solutions to ground-level ozone problems, received permission from the U.S. EPA in 1994 to adopt California standards in twelve northeastern states and the District of Columbia. Massachusetts and New York passed legislation to implement the California rules covering zero emissions, as recommended by the OTC.

Car makers were faced with a high-stakes gamble: comply with the zero-emissions decrees or fight them. Every instinct told them to fight: technology was unproven, and high development costs could never be recovered because of limited demand. Yet manufacturers had to consider complying: if CARB held fast to the rules, no company could afford to be shut out of the world's largest vehicle market, especially if a competitor chose to comply.

Vehicle producers hedged their bets by developing technology while fighting the decree. Their court challenges failed, but in 1996 CARB, recognizing that zero-emissions technology could not be mass-produced practically, backed away from the 1998 and 2000 mandates. Instead, companies were ordered to meet the 10 percent requirement in 2003 by introducing zero-emissions vehicles at their own pace beginning in 1997. New York adopted similar rules.[16]

Car makers were not told how to build zero-emissions vehicles, or how to sell them. In the short run, the only available technology was electricity. So, a century after abandoning electric vehicles, vehicle producers turned back to them. First on the market was GM's EV1, distributed through Saturn dealers in southern California and Arizona, beginning in 1996. Rather than adapt a model already being sold, GM chose to design an entirely new vehicle, a two-passenger sports car that could accelerate from zero to 60 mph in just 8.4 seconds. The other major U.S. producers—DCX, Ford, Honda, Nissan, and Toyota—followed quickly in the late 1990s with their own electric vehicles. Demonstrating the uncertainty of how to market electric vehicles, DCX and Nissan offered minivans; Ford and GM, compact pickup trucks; Honda, a small car; and Toyota, a small sport utility vehicle.

Given the uncertainty over technology, GM placed early EV1 cars with individual consumers only through leases rather than outright sales. Including tax credits for electric vehicles of 10 percent from the federal government and $5,000 from the California South Coast Air Quality Management District, leases were offered in southern California for thirty-six monthly payments of $399. Other companies leased electric vehicles at comparable rates.

Daily operating costs for an electric vehicle were lower than for a gasoline engine in 2000. An electric vehicle in 2000 could travel about 3 miles per kilowatt-hour of electricity. At the national average of about 10¢ per kilowatt-hour, 1 mile of driving an electric vehicle cost about 3.3¢ for power. The average gasoline-powered vehicle in 2000 went about 25 miles on 1 gallon of fuel, which cost about $1.50, so 1 mile of driving cost about 6¢ for power.

The major daily operational challenge for an electric vehicle in 2000, of course, was the need for frequent, time-consuming recharges. Honda's first-generation electric vehicle, powered by twenty-four, 12-volt, nickel-metal hydride batteries, had a range of only about 100 miles before requiring recharge. GM's early EV1 models, powered by twenty-six, 12-volt, lead-acid batteries, struggled to achieve even a 60-mile range, especially when driven in stop-and-go traffic with radio, air conditioning, and other accessories in use. Recharging the battery from 20 percent to 80 percent took nearly an hour in 2000, and a full recharge to 100 percent took several hours. Because of the limited range of early electric vehicles, recharging to 100 percent was desirable.

GM subsidized construction of 165 charging sites that offered free electricity around southern California, including airports, hotels, supermarkets, and shopping centers. Operators of electric vehicles had special 220-volt, 40-amp outlets installed in their garage to assure access to a recharge station. The limited range and long recharge time for electric vehicles in 2000 meant that they were suitable only for short round-trips from home or another recharge station.

Typical maintenance in 2000 for the first three years of operation was $1,000 for a conventional vehicle, $80 for an electric vehicle. An electric vehicle had no oil, air filter, spark plug, fan belt, timing belt, muffler, fuel injector, clutch, transmission linkage, or fuel line to replace. Brakes were unlikely to wear out because most of the deceleration was provided by the electric motor, which also functioned as a generator. The only maintenance expenses were to refill windshield washer and power-steering fluids and replace wiper blades. But the electric vehicle did have one major maintenance expense not faced by a conventional vehicle: the need to replace the batteries when they no longer held a charge. In 2000 it was still unknown how frequently batteries would have to be replaced, and how much the replacements would cost. At $15,000 or $20,000 and with a five-year life, nickel-metal hydride batteries were prohibitively expensive in 2000.

Hybrid engines, first offered by Toyota in Japan in 1997 and in the

United States in 1998, used batteries at low speeds and then switched to a diesel engine at higher speeds. Both motors could help with hard acceleration or steep climbs. The nickel-metal hydride battery pack was recharged by the engine. Toyota claimed 66 mpg for its first hybrid vehicle, though other testers reported considerably lower efficiency.

Early testers for newspapers and enthusiast magazines could not avoid negative judgments about the electric vehicles:

> A vehicle that makes sense for very few people.[17]
>
> What should have been a routine, perhaps even pleasant, commute in an EV became a nightmare.[18]
>
> Electric cars are fine, even fun, for those with a short commute, a predictable driving pattern, a willingness to be stared at—and a gasoline powered car in reserve.[19]
>
> Without a sudden and unexpected breakthrough, the dream of the pure, battery-driven car looks destined to be left in the technological slow lane.[20]

No automotive industry analyst in 2000 could safely predict the future of electric and other alternative-power vehicles. More than any other element of the changing motor vehicle market, the future of gasoline power was subject to second-guessing from both extremes. Many automotive "experts" in 2000 were rejecting all alternative-fuel vehicles as unrealistically out of step with consumer preferences, yet at the same time others were anticipating imminent serious consideration of many alternative-power sources.

The "realists" had plenty of ammunition in 2000. With gasoline less than $2 a gallon, early consumer interest in electric vehicles in California was minimal. GM leased only twenty-four electric vehicles a month in the first two years of availability; Honda, only twelve in the first year; Toyota, fifty a month in the first year by offering them nationwide and not just in California. Surveys clearly showed that consumers were willing to buy electric vehicles only if they had the features of a compact car but at a lower price. An electric vehicle with a limited range and long recharge time, priced at a luxury car level, generated no consumer interest.

Yet in 2000 electric-powered vehicles were *almost* competitive with gasoline-powered ones. The technological improvements, infrastructure, and cost structure needed to make electric-powered vehicles fully competitive with gasoline-powered vehicles in 2000 were marginal rather than fundamental. A 1998 report from the Office for the Study of Automotive Trans-

portation at the University of Michigan predicted that 20 percent of vehicles would use fuels other than gasoline in 2007. The report was based on the opinions of more than 200 industry officials. Vehicles powered by electricity and natural gas were expected to hold 2 percent of the market each in 2007; hybrid-electric, diesel, and alcohol or alcohol-gasoline mixture engines, 5 percent each; and propane engines, 1 percent.

In the absence of a sudden trauma, such as prolonged warfare in the Middle East oil fields, the fate of alternative-power vehicles in the early twenty-first century seemed likely to fall between the extreme pronouncements of both optimists and pessimists. Vehicles powered by electricity seemed likely to become much more common, at least in California and the Northeast, given the relatively modest changes needed. But other alternative fuels appeared likely to remain extremely exotic in the absence of unpredictable breakthrough technology.

9 *From Dealing with Customers . . .*

My daddy says all car salesmen are crooks.

—Seven-year-old girl, reporting to her father, a car dealer, what she had heard another child say at a birthday party

Negative perceptions of automotive dealers changed little through the twentieth century. A 1914 automotive industry study reported that "early retailers were incompetent, doing little more than passing along orders to the factory and informing customers when their ordered vehicles had arrived. . . . The automobile industry from the start to the present day has been an industry of extravagance . . . from the standpoint of the retailer." Dealers selected expensive locations, erected fancy buildings, paid high salaries to sales agents, spent lavishly on advertising, and offered gratuitous service.[1] In 1958 a successful automotive dealer wrote that "automobile dealers, as a group, have developed a considerable degree of consumer distrust. The dealer who develops a high-integrity image will loom high by comparison. It should never be forgotten that many people still think of automobile dealers and their salesmen as shysters, confidence men or old-time horse traders."[2] And a 1996 psychological test administered to top automotive salespeople found that a top salesperson "is inflexible, doesn't have much empathy, can't reason abstractly, and is not particularly open or thorough." The best salespeople were most likely to be skeptical, urgent, ego-driven (and persuasive), risk-taking, and assertive. "They have an above-average need to persuade and an above-average level of self-confidence that allows them to bounce back from rejection. They are assertive and want to get things done immediately."[3]

A *dealer* can be defined as someone who completes transactions, who engages in trading and distribution, or who bargains and makes arrangements for mutual advantage. Inherent in the etymology of the word is the sense that the bargain being struck is fair and just to all parties. In the au-

tomotive industry, a fair and just deal gives the customer an attractively priced vehicle and the dealer a reasonable rate of return on investment. But in the haggling environment of twentieth-century dealerships, the customer left the showroom feeling that the dealer had "won" or "lost" a contest rather than arranged a mutually advantageous transaction.

Incompetent Early Dealers

The unflattering judgment of dealers in 1914 came from a Curtis Publishing Company report, one of the first independent assessments of the U.S. automotive industry. Curtis, a leading publisher, wanted to know why few motor vehicle producers were advertising in magazines, even though at the time magazines were the most important medium for reaching a national audience simultaneously. Curtis was interested in the potential of the automotive industry as a future source of revenue, because its *Saturday Evening Post* was carrying about 60 percent of all magazine advertisements for new cars.[4]

A pioneer in the scientific study of market trends and consumer behavior, Curtis established a division of commercial research in its advertising department in 1911. Two years later, the division manager Charles Coolidge Parlin and assistant manager Henry Sherwood Youker undertook a year-long study of the automotive industry, which was compiled in a voluminous report with an unappealing title, *Automobiles Volume 1B. Gasoline Pleasure Cars. Report of Investigation.* The Curtis report concluded that the future of automotive advertising was bright if dealers improved their marketing ability.[5]

Cars Sold for Pleasure

Early automotive dealers were incompetent, according to the Curtis report, at least in part because most were drawn from three unpromising groups: nephews and favorites of the well-to-do, those who had failed in other businesses, and bicycle repairers. Wealthy people set up their dependents in automotive sales because the trade seemed more "genteel" and respectable than other types of merchandising. Selling cars offered opportunities to make money without engaging in real labor and to go "joy riding" in the product. The second group, described as "men who had failed in other lines of merchandising and were looking for a new field of adventure," turned "naturally" to selling cars, while "those who were succeeding in other lines naturally hesitated to give up profitable employment for one

so new and uncertain as the auto business."[6] Not wishing to be bound to unreliable dealers, manufacturers typically placed a thirty-day termination clause in the franchise agreement.[7] The third group, bicycle repairers, had little skill in salesmanship and did not know much about automobile engines, but because they had experience with rubber tires and ball bearings, they could at least service the chassis and transmission. Unlike the other two groups, bicycle repairers evolved eventually into automobile repairers.[8]

Many early dealers sold cars as a sideline. Some were shopkeepers who also sold hardware, harnesses, wagons, bicycles, and tires; others were tradespeople, such as blacksmiths, electricians, locksmiths, or livery stable operators. William Metzger opened a store in 1898 at 254 East Jefferson Street in Detroit that sold Columbia bicycles, Remington typewriters, and business machines, in addition to cars. Reflecting the uncertain technology of the new invention, Metzger sold Mobile steamers, Waverly electrics, and Winton gasoline-powered cars, and he added Oldsmobile in 1901.[9] Metzger went on to play a major role in the rapid growth of Cadillac, which hired him as sales manager in 1902, two months after the company was reorganized from the bankrupt Henry Ford Company. At the nation's first full-scale auto show, held in New York in January 1903, Metzger took orders with deposits for 1,000 Cadillacs, enough to finance the company's start of production. Metzger sold his dealership in Detroit in 1905 to work full time for manufacturers.

Instead of investing in mechanics or inventory, early dealers constructed lavish marble palaces on expensive parcels of land (Fig. 9.1). They clustered on highly visible downtown thoroughfares, often called "Automobile Row," such as Broadway in midtown Manhattan, South Michigan Avenue in Chicago, North Broad Street in Philadelphia, and East Jefferson Street in Detroit.[10] By 2000, dealers had long since moved to the suburbs, but shells of the palatial showrooms still remained along the former Automobile Rows, reused for less glamorous warehousing and industrial purposes, or standing vacant and derelict.

Early dealers could afford to be incompetent, because most early buyers were caught up in a fad, "a craze in which the psychology of the masses impelled individuals to make purchases not warranted by their needs or buying power." Early car buyers had "a longing for the possession of a rare thing that would separate the owner from the common herd" and therefore were determined not be excluded from the select few who owned vehicles. Because the supply of vehicles was less than the demand, buyers

9.1. Marmon dealer, 1920s. Early car dealerships were elaborate buildings that emphasized the glamor and luxury of motoring. (National Automotive History Collection, Detroit Public Library)

waged "a vigorous competition, almost a panicky struggle . . . to secure the coveted prizes."[11]

The Curtis report saw the automobile industry as "an industry of extravagance from the standpoint of the purchaser. Comparatively few people who buy an automobile can afford one. The initial expenditure is larger than any ordinarily made for pleasure by the average family, and the automobile is bought by the average purchaser today essentially as a pleasure car." For this reason, buyers "figured costs in a less businesslike manner than if [they] had bought for commercial purposes. . . . [I]t was an extravagance anyway and a little expense more or less was not to be considered."[12]

Impatient to fulfill his desire for pleasure, the buyer—almost always a man—became reckless. It galled him to see his friends ride by while he held the money in his hand and waited for delivery. He had to have a car of some kind, so he would pay a higher price to get what he wanted. If he could not get his first choice or his second, then some other car would do—but he had to have a car.[13]

The most common term in the United States for an automobile between 1900 and 1920 was *pleasure car*. The name was appropriate, because early automobiles were sold to wealthy people as toys rather than for utilitarian

purposes. During World War I, when driving a "pleasure car" was seen as an unpatriotic waste of the nation's resources, manufacturers and dealers launched a successful campaign to substitute *passenger* for *pleasure*, to reflect a car's practical utility.

William Metzger recorded the professions of his first twenty customers (all of them men) for Mobiles Steamers in 1898–99: four each "capitalists," merchants, and physicians; three "general businessmen"; two manufacturers; and one each broker, plumber, and printer. The occupations and places of record of the first twenty buyers of Winton cars, according to company records, included the following:

2 mechanical engineers, Pennsylvania
2 railroad car manufacturers, Pennsylvania
1 oil pipe manufacturer, Pennsylvania
1 capitalist, Pennsylvania
2 coal operators, Pennsylvania
1 coal dealer, Pennsylvania
1 brewer, Pennsylvania
1 engineer, New Jersey
1 locomotive manufacturer, New Jersey
1 physician, New York
1 electric manufacturer, Ohio
1 piano manufacturer, Missouri
1 flour miller, Minnesota
2 hosiery manufacturers, Ontario
2 dry goods merchants, Ontario[14]

The physicians may have bought cars so that they could reach patients more quickly and visit more of them, but Metzger's other early customers undoubtedly bought their cars for pleasure.

Racing Sells Cars

Cars were sold as objects of pleasure rather than utility in the early years of the twentieth century through the sport of racing. In the words of an early auto industry chronicler, races were "competitive tests designed to show prospective purchasers which make of car was best. Thus they may be regarded primarily as marketing devices."[15] The Chicago *Times-Herald* race of November 28, 1895, was not merely the first important race in the United States, it was arguably the first important date or event of any sort in U.S. automotive history.

A century later, little had changed. Motor vehicle racing was America's second most popular spectator sport in 2000. Major events attracted hundreds of thousands of spectators, as well as comprehensive television and radio coverage, and the leading drivers were popular personalities. Ford and General Motors were especially active in racing, believing the adage "win on Sunday, sell on Monday." Vehicles sponsored by Ford during the 1990s carried bodies resembling its best-selling Taurus car. "We want to continue to make the link between the Taurus as the American family car and NASCAR as the American family racing series," said Ford's global marketing manager for racing, Torrey Galida. "NASCAR is a direct avenue to customers."[16]

Reliability Races. Two types of races captured the public imagination from the beginning of the automobile era: reliability and speed. Reliability races were especially important at the turn of the twentieth century, because people hesitated to buy early vehicles that were unreliable and could not be trusted for sustained operation. Engines, axles, and transmissions constantly needed adjustment. Axle shafts crystallized, universal joints snapped, crankshafts broke, pistons cracked, valve stems warped, clutches seized, gears stripped, flywheels loosened, and cylinder walls wore rapidly. Springs lasted less than 2,000 miles; tires, less than 3,000 miles.[17] The frequent maintenance and repairs were expensive, and dealers were not qualified to do the work.

Lack of standardization made repair work nearly impossible. The engine could be air-cooled or water-cooled; mounted on the chassis horizontally or vertically; placed under the body, under the front hood, or above the rear axle. The transmission could be planetary or sliding gear; the ignition by battery (dry or storage) or magneto (high or low tension); the drivetrain by shaft, bevel gears, or chain (double or single); the steering by bar, tiller, or wheel.[18]

The cost of replacements was high. A set of four new tires in 1910 cost $30 for 30-inch by 3-inch tires for the Ford Model T and other small cars, $50 for 4-inch tires for medium-sized cars, and $80 for 5-inch tires for large cars.[19] New vehicles carried warranties of only ninety days, and even then covered only parts and not labor. If something broke after ninety days, the owner had to pay the full cost of parts. Owners in Detroit simply took the cars back to the factories for repairs, but in the rest of the country dealer service was an important issue.[20]

Ford Motor Company tried to convince ordinary people that buying a

car was not merely a safe investment, it was practical as well. A Ford advertisement proclaimed: "Nobody Mortgages His House to Buy a Ford." Dealers were trained to tell customers that the Model N cost 48¢ a pound, compared to a per-pound price of between 75¢ and $1 for other cars. Compared to more expensive cars, the Model N consumed half the gas and oil, depreciated in value more slowly, and used tires that lasted much longer and cost half as much. Showroom walls had photographs of Fords operating better than expensive cars in snow and mud. Ford's successor to the Model N, the Model T, was also advertised as a practical car. According to an early Ford advertisement for the Model T, "No car under $2000 offers more, and no car over $2000 offers more except in trimmings."[21]

Other manufacturers tried to assure buyers that their cars were reliable as well. In 1903, its first year of production, Cadillac advertised, "When you buy a Cadillac you buy a round trip." In 1905 Pope Manufacturing Company advertised its $3,200 Pope-Hartford with the claim, "Each car tested to a mile a minute flat." An advertisement for Oldsmobile's 1905 Curved Dash stated, "You see them wherever you go; They go wherever you see them."[22]

Racing was a critical factor in convincing Americans that motor vehicles were reliable. The first important reliability race, sponsored by the Chicago *Times-Herald,* was inspired by a 78-mile race from Paris to Rouen, France, in June 1894. *Times-Herald* publisher Herman H. Kohlsaat decided to schedule a similar reliability race from Chicago to Milwaukee. None of the eighty-nine prospective entrants was prepared for the first race date in July 1895, and when only one was ready for the second date, September 2, Labor Day, the race was again scuttled.

Only two vehicles were ready to go on the third date, November 2, 1895, but the *Times-Herald* had generated so much publicity that Kohlsaat felt compelled to run some sort of race, so he designated a "consolation run" from Chicago to Waukegan with a $500 prize. The winner, completing the race in 9 hours, 22 minutes, was a German Benz driven by Oscar Mueller and adapted by his father, a Decatur, Illinois, machine tool operator. The other entrant, built and driven by J. Frank Duryea, ran into a ditch dodging a farm wagon.

Kohlsaat scheduled the race a fourth time, for November 28, 1895, and reduced the distance to 54.36 miles from Jackson Park on Chicago's South Side north to Evanston and back. This time eleven entered, but only six actually appeared at the start. A large crowd saw the six vehicles off in blustery winds, with temperatures in the 30s, a day after a heavy snowfall had

paralyzed the city. Unable to navigate the slushy streets, four of the six entrants dropped out of the race. A gasoline-engine Benz adapted by the De LaVergne Refrigeration Company withdrew when it couldn't get traction in the snow. A Benz adapted by the Frenchman Emil Roger and owned by R. H. Macy & Company department store lasted eight hours, getting all the way to Evanston and most of the way back, until its engine died at West Parkway. Along the way, the Macy-Roger crashed into a horse car on Michigan Avenue in front of the Art Institute of Chicago, hit a sleigh, and rammed a hack in Rogers Park when the hack driver refused to give the right of way.

An electric car built by William Morrison of Des Moines, Iowa, was driven by the company head Harold Sturges north on Michigan Avenue through downtown to Lake Shore Drive before the battery was depleted. Morrison attracted considerable publicity when he showed the seven-passenger vehicle—considered the first electric in the United States—at a parade in 1890. Since he himself was uninterested in manufacturing cars, however, he sold it to the American Battery Company. An Electrobat electric made by Henry Morris and Pedro Salom of Philadelphia also depleted its battery on Lake Shore Drive. A number of Electrobats were sold as taxicabs in New York and Philadelphia.

In the darkness of the evening, the crowds long since dispersed, two cars completed the course—the same two entrants from the November 2 "consolation run." First across the finish line this time was the Duryea, which started the race at 8:55 A.M. and finished 10 hours, 23 minutes later, at 7:18 P.M. Excluding stops for repairs, the Duryea averaged 6.66 mph through the city. The other finisher, the Mueller-Benz, delayed at the start by drivebelt problems, took about an hour longer. The original driver of the Mueller-Benz, Oscar Mueller, collapsed from the strain and exposure, so Charles B. King—the umpire assigned to accompany Mueller—completed the drive in his place.[23]

For completing the race with the fastest time, Duryea was awarded $2,000, while Mueller received $1,500, and Macy and Sturges, $500 each. Morris and Salom received a gold medal for "safety, ease of control, absence of noise, vibration, heat or odor, cleanliness and general excellence of design and workmanship." The first major event in the history of the U.S. automobile set a pattern for the future: the electric vehicle had many advantages, but only the gasoline engine could power a vehicle through the Chicago snow.

Duryea achieved an even greater racing triumph a year after the Chi-

cago race, when he won the Emancipation Day race from London to Brighton, England, defeating larger, more powerful European competitors. The race, held on November 14, 1896, was named to commemorate the repeal of Britain's Locomotives on Highways Act, which had imposed restrictions on the operation of motor vehicles in England, such as requiring a person to walk in front of a vehicle to warn of its arrival and limiting the speed at which vehicles could travel.

A few months before the Chicago race, Duryea Motor Wagon Company had become the first company organized in the United States to manufacture automobiles. It built thirteen vehicles during 1895–96, thereby becoming the first motor vehicle company to build in volume for sale. After selling the company in 1898, Frank Duryea developed the Stevens-Duryea car, which was made until 1915. He died in 1967, at age ninety-seven.

Frank's older brother Charles E. Duryea—the "restless, outgoing one, a promoter, a salesman, a dreamer"—claimed principal credit for developing the car. The most authoritative 1920s automotive industry study even credited Charles with driving the car in the 1895 Chicago race and failed to mention Frank at all.[24] Frank, the "quiet, reserved and serious" brother, was willing to share credit; his headstone reads "co-inventor first American gasoline automobile." A bitter dispute raged among the brothers' descendants concerning the role of each brother. According to Richard Scharchburg's definitive 1993 study, Charles prepared crude sketches of a gasoline-powered motor vehicle when both brothers were working for the Ames Manufacturing Company in Chicopee Falls, Massachusetts, and in March 1892 convinced his younger brother to quit his job and work full time building the vehicle. Broke and depressed by his failure to start the single-cylinder, double-piston engine, which lacked a carburetor, ignition, and starting device, Charles returned to the brothers' hometown of Peoria, Illinois, in September 1892 and made bicycles. With the financial and technical help of Erwin F. Markham, Frank rebuilt the engine and got it to run on September 21, 1893. A second design, with an improved transmission, was successfully operated on January 18, 1894, and was run in the 1895 Chicago race.[25]

Many demonstrations of reliability followed the Chicago race; for the most part these were staged by individual manufacturers. For example, Ransom E. Olds promoted his car's toughness in 1901 by ordering Roy D. Chapin, a twenty-one-year-old gear filer at the Olds factory, to drive a Curved Dash model 700 miles from Detroit to New York so that it could be displayed at the second annual New York Auto Show. Arriving in New

York dirty and disheveled after the seven-day trip, Chapin was refused entry into the Waldorf-Astoria Hotel where his boss was staying.[26] Chapin went on to become president of Hudson Motor Company.

Motorists competed to cross the country in a car (Fig. 9.2). Mr. and Mrs. John D. Davis took four and a half months to drive a Duryea from New York to Chicago in 1899, including a one-month layover in Toledo for repairs. A Winton started in San Francisco in 1901 but made it only as far as Nevada, where it became bogged down in the sand. Dr. H. N. Jackson, a Vermont physician, drove a Winton 3,000 miles from San Francisco to New York in sixty-three days in 1903, in what was probably the first transcontinental trip completed by a nonprofessional driver in his own car. A Packard made the same trip a few weeks later in sixty-one days, and an Olds made it from New York to Portland, Oregon, in only forty-four days.

9.2. Cross-country endurance test, 1903. Lester L. Whitman (left) and Eugene I. Hammond drove the front wheels of their Oldsmobile Curved Dash into the Atlantic Ocean at City Point Beach, Boston, on September 22, 1903. They had backed the rear wheels into the Pacific Ocean at San Francisco on July 6, 77 days earlier. (National Automotive History Collection, Detroit Public Library)

The most impressive early reliability contest was the Glidden Tour, organized by Charles J. Glidden. The first tour in 1905, 1,000 miles across New England country roads, attracted thirty-three entries. Any member of the American Automobile Association (AAA) could enter, but because the car had to be driven by its owner, most entrants were manufacturing executives, including J. D. Maxwell, R. E. Olds, Charles E. Walker (Pope-Hartford), and Walter C. White. Scoring was based on frequency and seriousness of troubles each car encountered. The highest scorer and winner of the Glidden Cup was a Pierce-Arrow driven by Percy Pierce. All twenty-eight finishers received certificates of performance.

The Glidden Tour and others like it showed the need for improved components: axles and chassis springs broke, tires punctured frequently, brakes wore out. But tours also demonstrated the reliability of early gasoline engines, which were relatively trouble-free. The number of vehicles participating in the Glidden Tour increased to forty-six in 1907, but by 1909 declined to twenty-one: manufacturers "were enjoying too much prosperity" and no longer needed to prove their products' reliability. Long-distance trips continued to challenge American motorists and attract attention even in the 1920s. For example, a team of AAA officials drove a Cadillac nonstop from Washington, D.C., to San Francisco during the summer of 1925 in 4 days, 18 hours, 30 minutes.[27]

Speed Races. The first speed race in the United States was held in 1900, according to the AAA. It was a 50-mile race on Long Island, New York, roads, and the winner was A. L. Riker in 2 hours, 3 1/2 minutes. In Europe—where a well-developed road system dated from the time of Napoleon if not the Romans—nearly all races were run on public roads. But in the United States, which had a poorly developed road system, most early speed races were held as curiosities at horse tracks and county fairs. "Not only were [horse tracks] available, they had fences and turnstiles; you could control entry and charge admission. In addition, since you needed some sort of gimmick to attract a crowd, the most obvious was to advertise speed."[28]

Possibly the most influential early speed race was held at the Grosse Pointe race track outside Detroit, October 10, 1901. The day began with a parade of 100 cars, electric cars first, followed by gasoline cars, then steam cars. The first race, a 5-mile distance for steam cars, was won by R. H. White of Cleveland, in a White steamer. A race for electrics followed, then a 1-mile race for gasoline engines won by H. H. Lytle of Toledo. Next, an exhibition run by Winton demonstrated dramatically the attraction of gas-

oline-engine cars: it covered 1 mile in 1 minute, 12.4 seconds, compared to 1 minute, 52 seconds for the fastest steam car and more than 4 minutes for the fastest electric car. The final event of the day was a 10-mile race (reduced from 25 miles because earlier races had taken longer than expected). Three entered the race, but W. N. Murray of Pittsburgh withdrew after finding a leaking cylinder. One of the two competing drivers was Alexander Winton, an expert race driver, holder of several speed records, and the country's second-leading automobile manufacturer in 1901. The other was Henry Ford. Winton led in the early going, but Ford pulled ahead on the eighth lap and won easily, in 13 minutes, 23.8 seconds—an average of nearly 45 miles per hour. The victory was popular with the large crowd, because the local boy had defeated the "professional" from Cleveland.[29]

The Indianapolis Motor Speedway, built in 1909 for manufacturers to test their vehicles, quickly emerged as the most important track for racing motor vehicles rather than horses. The Indianapolis track hosted three races as part of the first national championship series in the United States, organized by the AAA in 1909, the only races not run on public roads (Fig. 9.3). A year later the Speedway hosted dozens of races over three holiday weekends, including nine of nineteen national championship races. The original track at the Indianapolis Speedway was a mix of crushed stone and tar, but after the cars tore up the surface at the first three-day meet in 1909, and several drivers died, it was resurfaced with 3.2 million 10-pound bricks laid on their side on a bed of sand and fixed with mortar.

Faced with low attendance spread over too many events, the Indianapolis organizers decided in 1911 to hold only one race that would pay a very large purse of $25,000, including $10,000 to the winner. The Memorial Day race was an immediate success, attracting more than 60,000 spectators and 40 racers. The race was based on distance, although the organizers had thought of basing it on time instead. "They considered a 24-hour race but decided a 500-mile contest would have greater appeal to the public."[30]

The first Indianapolis winner, a Marmon Wasp equipped with a special six-cylinder engine, driven by Ray Harroun, took 6 hours, 42 minutes, 8 seconds to cover 500 miles, at an unheard-of average speed of 74.6 miles per hour. The race started in mid-morning and lasted until late afternoon. A Duesenberg driven by Peter DePaolo won in 1925 in 4 hours, 56 minutes, 39 seconds, averaging 101.13 miles per hour, the first Indianapolis racer to win in less than 5 hours and average more than 100 miles per hour. By the end of the twentieth century, the race was attracting 500,000 spectators and could be completed in less than three hours.

9.3. First race at Indianapolis Motor Speedway, 1909. Only five of eighteen cars finished the race, and three drivers died. Fred Ellis, driving car no. 53, a Jackson, survived the race but did not finish. (National Automotive History Collection, Detroit Public Library)

Racing declined in the 1920s. "Because of the visible perfection of the motor car, manufacturers need no longer direct any great efforts towards proving the ability of their cars to show speed and to withstand 'punishment.' Spectacular accomplishments are no longer necessary," opined auto industry historian Ralph Epstein.[31] Midget cars were the mainstay of racing during the 1930s and 1940s. Indianapolis became an annual anomaly, attracting a specialized form of race car. Neglect during the Great Depression and World War II left even the Indianapolis track dilapidated until it was purchased in 1945 and refurbished by a Terre Haute businessman named Anton Hulman.

Racing regained popularity in the United States after World War II primarily through stock-car races. Americans related better to stock-car racing, because the cars had bodies that bore clear external resemblance to mass-produced vehicles, in contrast to the specially built "Indy" race cars. Stock-car racing in the United States may have been an outgrowth of the 1920s Prohibition era, when gangsters and operators of illegal stills altered ordinary passenger cars so that they could move faster than police cars. Stock cars were raced for pleasure during the 1930s, especially in southeastern states, notably on the sand at Daytona Beach, Florida.

The most important figure in the development of stock-car racing in

the United States was William France, a Daytona Beach, Florida, gas station operator and part-time driver, who took over the local races in 1938. France consolidated southern race track owners into a powerful confederation—the National Association for Stock Car Auto Racing (NASCAR)—in 1947, and he created two major super speedways with tracks exceeding 1 mile, one at Daytona in 1959 and the other at Talladega, near Birmingham, Alabama, in 1970.

Other corporations invested heavily in NASCAR once researchers demonstrated that advertising in such races was especially cost effective. By the late twentieth century each stock car was brightly painted with the logo of its sponsor, an American commercial icon such as McDonald's or Budweiser. Valvoline Motor Oil calculated that it gained $56 million in commercial exposure in 1998 based on the amount of time its logo affixed to cars or billboards at NASCAR races actually appeared on television. More than 70 percent of NASCAR fans were predisposed to buy products from companies that sponsored their favorite team, according to an organization that monitored corporate sponsorship.[32]

Starting in 1949, NASCAR's most popular and prestigious series, the Winston Cup, attracting the top drivers and biggest crowds, was sponsored by R. J. Reynolds Tobacco Holdings, Inc., the country's second-largest tobacco company—prohibited like other tobacco companies from most other means of advertising. The second-level stock-car circuits were known as the Busch Grand National, named for the manufacturer of Budweiser beer, and the Craftsman Truck for pickups, named for the Sears department store's brand of tools.

Racing of specially built vehicles also regained popularity, although the sport was hampered by a split between owners of the cars and backers of the Indianapolis 500. A separate organization, Championship Auto Racing Teams (CART), organized races beginning in 1996, including one on Memorial Day that lured the most prominent drivers away from Indianapolis. In response, Speedway owner Tony George organized the Indy Racing League (IRL) with vehicles powered by passenger-car engines rather than specially built engines. Together the three major racing circuits of NASCAR, CART, and IRL attracted more than $1 billion a year in sponsorship revenue in 2000, and drew higher television ratings in the United States than any other sport with the exception of football.

Professionalization of Dealers

Henry Ford believed that a car "was 75 percent complete when it left the factory and 25 percent of the completion was done by the dealers." Dealer finishing included attaching and repairing tires, tuning up the engine, and filling up the gas tank. In 1908–10, frustrated with incompetent dealers, the newly established Ford Motor Company looked for other ways to sell vehicles.

Ford Sells Direct

The Ford Motor Company's first sales manager, Norval A. Hawkins, proposed selling cars directly to the public. Hawkins, an auditor with Hawkins-Gies & Company, which had been auditing Ford's books since 1904, was hired as Ford's general sales manager in 1907. According to Charles D. Hastings, president of the Hupp Motor Company, "Mr. Hawkins was regarded as being the most fertile in sales suggestions of any man in the industry."[33] "Mr. Hawkins is perhaps the greatest salesman that the world ever knew," claimed Luman W. Goodenough, attorney for the beneficiaries of the estate of Philip Gray, Ford's first president. "Original in idea, forcible in presenting it, a perfect dynamo for work, and a man who gets the quickest execution of any man I ever knew. He originated a great many ideas which made possible the proper marketing of [the Model T]."[34]

Hawkins's combination of accountant and sales manager served Ford well. As accountant he tried to minimize production costs, which kept down the price of the cars and thereby promoted sales—the goal of the sales manager. Hawkins "had great ideas of expanding the business of the company, and it was always a race between the production end and the sales end to know which was going to be ahead. . . . Hawkins was always ahead, and he took great satisfaction in doing that."[35] According to Hawkins himself, "[t]he opportunity had arrived when sales would be limited only by the ability of the company to finance and manufacture."[36]

Hawkins proposed that Ford sell cars directly to consumers through company-owned branch houses run by Ford employees, who would be paid a salary plus a bonus on sales.[37] Selling cars directly to the public, he argued, would reduce costs and therefore the final selling price, thereby increasing sales and raising profits, which the company would not have to share with independent dealers. Locating branch houses at strategic points where freight rates changed would also reduce costs.

Ford opened branch stores in 1907 in six cities (Boston, Buffalo, Chicago, Kansas City, New York, and Philadelphia), in 1908 in five more cities (Atlanta, Cincinnati, Dallas, Omaha, and Pittsburgh)—twenty-five altogether by 1910. The branches accounted for most of Ford's sales—62 percent in 1909, 79 percent in 1913—while independent dealers sold Ford cars in small towns beyond the service area of any branch.

To maximize visibility for consumers, Ford's early branch houses were located downtown. Typical was the Cincinnati branch, at 911 Race Street, a four-story building with a 36-foot frontage and 50-foot depth. The first floor, with a plate-glass window, was the showroom, where several cars, a motor, and a cut-out chassis were displayed on black-and-white marble floors. The second floor contained the stock room, where parts were stored and customers could buy tires, polishes, and other supplies. The third floor held vehicles not yet delivered to customers. The fourth floor was the repair shop.[38]

Hawkins believed that branch houses would stimulate sales by providing worried customers with a high standard of service, including trained mechanics and a large inventory of replacement parts. Each day, branches would send telegrams to Ford headquarters in Detroit listing needed replacement parts, which were shipped out before 4 P.M. the next afternoon.[39] Branches also had responsibility for supervising independent dealers in smaller towns in the surrounding territory. Mechanics were sent from the branches to local dealers to teach repairs and to fix broken cars. Ford officials arrived without advance warning at local dealers to inspect operations and assure availability of an adequate inventory of replacement parts.[40]

But selling directly to the public proved impractical for Ford's expansion plan. Ford could not open branches fast enough to keep up with the enormous growth in demand for cars that it had created, nor could it find enough qualified people to staff the branches.[41] Ford officials believed that a manager had a much less strong incentive to work hard to maximize sales and minimize expenses than an independent dealer with a direct financial investment in the business. In his history Epstein listed some of the problems. "It is difficult to get good managers who have no money invested. . . . If a dealer has a financial interest in his own company, he is found to be much more satisfactory than a branch manager, who has practically no financial interest in the branch." He noted that "even a . . . 'fair to middling' dealer lies down and quits completely when put in charge of a factory branch—where the urge of actual, personal incentive is less strong."[42]

In the 1910s and 1920s most companies utilized a combination of branches, distributors, and dealers to sell cars. Branches were set up in large cities, and dealers in smaller communities. Distributors acted as wholesalers, buying cars from manufacturers and in turn selling them to dealers in their service areas. Distributors were typically selected from the largest and strongest dealers, and they continued to sell cars and parts directly to the public as well as to local dealers. Manufacturers rarely delivered cars directly to individual dealers until the 1920s.[43]

Distributors supported local dealers by supplying replacement parts, sending out trained mechanics, and assisting with financing. In exchange for performing these functions, a distributor pocketed a 5 percent profit, because it received cars from the manufacturer at 25 percent off list price, but was allowed to sell them to local dealers at only 20 percent off. Independent distributors became less common in the 1920s, although some lingered into the 1950s. Ford converted its branches to company-owned distribution centers. Ford distributors also completed manufacture of vehicles that were shipped from Michigan partially assembled.

Selling through Independent Dealers

The franchise system was common by the 1920s. Under the franchise system, dealers were not legal representatives of the manufacturers, but independent merchandisers who purchased vehicles from the factory at wholesale prices and sold them to customers at retail prices. An independently owned dealer obtained an exclusive franchise to sell a manufacturer's vehicles within a specified territory. No other dealer located within that territory was permitted to sell the same manufacturer's vehicles. In exchange for the exclusive franchise, the dealer agreed to purchase a predetermined number of vehicles, maintain an agreed-upon inventory of replacement parts, and repair vehicles at agreed-upon prices using factory-authorized parts. The dealer also agreed to display signs, arrange the showroom, and run advertising in accordance with the manufacturer's overall marketing strategy.

The vehicle manufacturer is one of the world's largest corporations, with hundreds of thousands of employees and hundreds of billions of dollars of assets. It is also one of the world's largest advertisers of its products, and it pinpoints consumer preferences with some of the world's most elaborate market analysis. GM conducted extensive consumer research beginning in the 1920s, and the Ford Motor Company returned to prosperity in the 1950s in part by starting a consumer research division.[44]

In contrast, the dealer for most of the twentieth century was a small, independent business. Nearly all dealerships owned a franchise to sell one or two nameplates produced by one company at one location. The dealership's owner was typically a long-time resident of the community where the business was located, and the dealership was the only business he owned. A dealer gained knowledge of consumer preference by talking to friends and neighbors, some of whom were satisfied customers and some of whom were dissatisfied ones.

On the surface, the interests of manufacturers and dealers should be parallel: both are in business to sell the same product. In reality, some tension is unavoidable because they make money from selling the product in very different ways. The manufacturer makes money by selling as many vehicles as possible to dealers, and the dealer by selling as many as possible to consumers. A customer chooses to buy a specific brand of vehicle researched, produced, and advertised by the manufacturer, but the personal representative and spokesperson for that vehicle is the independent dealer.

As vehicle sales increased during the first half of the twentieth century, so did manufacturer revenues, but dealer revenues remained relatively flat. The combined net profit of U.S. car makers rose from $38 million on sales of 500,000 vehicles in 1914 to $1.3 billion on sales of 6.5 million vehicles in 1956 (the year Ford Motor Company shares were first sold to the public, and therefore the first year since 1921 that the company had reported earnings).[45]

The average dealer's net profit increased only modestly between 1914 and 1956. A typical dealer sold about three times more vehicles in 1956 than in 1914 but grossed about the same amount per vehicle and faced higher costs of doing business. A typical dealer in 1914 bought 50 vehicles from the factory at $1,500 each and sold them for $2,000, a gross profit of $500 per vehicle, or 33.3 percent of purchase price. The cost of doing business was about $200 per vehicle, leaving a net profit of $300 per vehicle, a 20 percent return on investment.[46] In 1956 a typical dealer bought 150 vehicles from the factory at $2,500 each, and sold them for $3,000, a gross profit of $500 per vehicle or 20 percent of purchase price. The cost of doing business in 1956 was about $375 per vehicle, leaving a net profit of $125 per vehicle, a 5 percent return on investment.[47]

The modest growth in the number of vehicles a typical dealer sold in a year resulted from a rapid increase in the number of dealerships. The historic peak was reached in 1949, when the United States had 49,173 dealers, averaging 110 sales apiece.

Early dealers were given franchises for entire counties or even states, but Ford's sales manager Hawkins felt such dealers could reach only a small percentage of prospective purchasers. Henry Ford promised in 1909 "to fix it so that people could buy cars in a hardware store."[48] That goal was never achieved, but as consumers clamored to buy Fords, Hawkins surveyed the country looking for places to award new franchises. He continually reduced each dealer's territory, and placed additional dealers in unoccupied territories. By breaking down the country into ever smaller territories, he ensured that every American—even those in rural areas—had access to a Ford dealer. Hawkins paid particular attention to sales figures for small towns and urban neighborhoods. A rural area or neighborhood with especially low sales would be taken away from one dealer's franchised territory and transferred to another dealer. Despite the small area allocated to each dealer, Ford agencies were in great demand.[49]

While reducing dealer territory, Ford encouraged dealers to sell more cars by offering them attractive high-volume incentives beginning in 1904. Dealers who sold more than 150 units a year obtained vehicles at 25 percent below the manufacturer's suggested retail price (MSRP), while dealers selling fewer than 150 a year paid 20 percent below the MSRP. To somewhat reduce the penalty on small dealers, Ford also offered a yearend rebate of 5 percent to a dealer selling between 50 and 150 cars, a rebate of 3 percent for selling between 25 and 50 cars, and a rebate of 2 percent for selling between 15 and 25.

Paying Cash for Vehicles

Transactions between dealers and factories and between dealers and customers were strictly on a cash basis in the early years of the motor vehicle industry. Given that incompetent dealers were selling unreliable products built by bankrupt manufacturers to an undiscerning public at high prices, cash transactions seemed prudent for all concerned. A "capitalist" who rejected investing in the motor vehicle industry in 1900 later recalled, "I had so much more capital than all the others in the game that I thought I had better stay out and keep it."[50]

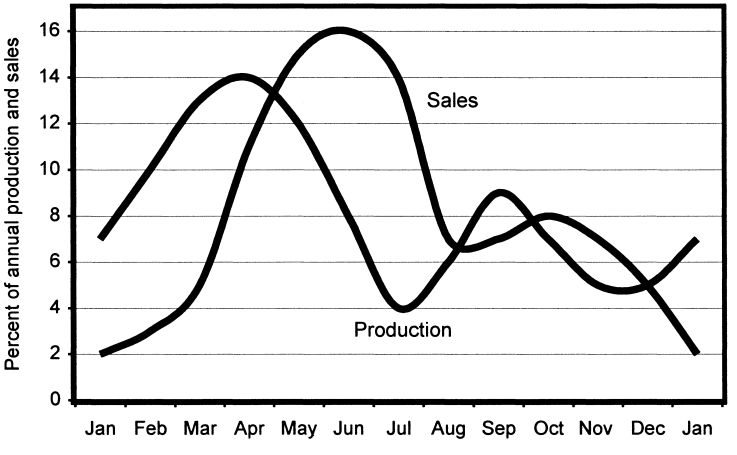
Dealer-Manufacturer Transactions

When R. E. Olds began to make the first large-production vehicle, the Curved Dash Olds, in 1900, he insisted on a cash basis with his dealers. Other large-quantity producers followed the practice, which quickly be-

came standard industry policy. Transactions between dealers and manufacturers were on a cash basis for two principal reasons: first, because even financially responsible dealers faced annual cash flow problems; second, because the early manufacturers needed the infusion of cash from dealers to help pay for the production of the vehicles.

Seasonal Sales And Annual Models. Early dealers faced annual cash flow problems because sales were highly seasonal—one-half were in the spring, only one-tenth in the winter. The sales year began September 1, and about one-fourth of the year's sales were made by Thanksgiving. With almost no sales in the winter, dealers laid off most of their sales force just in time for the holiday season (Fig. 9.4). A dealer needing financial help through the winter borrowed money from a bank or finance company, not from the manufacturer. The spring sales season started in March, increased in April and May, peaked in early June, and collapsed in July and August, before recovering in the autumn.[51]

The large seasonal fluctuation was exacerbated by the practice of introducing model changes at the same time every year. The Curtis report noted, "The announcement of annual models accentuated these two great selling seasons, spring and fall, and put a stagnant summer season between



9.4. Annual cycle of production and sales, 1910. Most cars at this time were sold in the spring and early summer, and few were sold in the winter. Poor road conditions and cold, snowy weather discouraged operation of lightweight open cars. Parlin and Youker, "Automobiles Volume 1B," p. 785.

them, and the fact that these seasons exist with many manufacturers has educated the public to look for new models in mid-summer and has compelled reluctant manufacturers to bring out annual models."[52] Manufacturers initially introduced new models during the auto shows, which were held in the winter to stimulate interest in the upcoming buying season. "But companies moved up the annual change to the autumn to give them more time to advertise for the spring buying season, as well as to stimulate a secondary buying period in the autumn."[53]

Manufacturers disliked the rhythm of the annual cycle, because it compelled them to risk building most of their vehicles in anticipation of demand rather than in response to it. Production rapidly dropped off after the September 1 start of the auto year, and by October 1 it nearly ceased, so that dealers could sell out their stock before winter. During the winter, when few cars were sold, manufacturing began again, so that cars would be ready for delivery in the spring. Production slackened in the spring to allow dealers to clear out old models. When the spring sales season ended around July 1, the factory had to start building the next model year.[54]

Manufacturers moved away from the annual model change during the 1910s. As the Curtis report noted, "[t]he rapid evolution of the automobile, involving frequent and sometimes radical mechanical changes, has made new models at frequent intervals necessary, for the purchaser demands the latest improvements."[55] The situation altered with Ford's successful Model T, which remained virtually unchanged from year to year. This effectively killed the annual model change for two decades.

The annual model change was revived by General Motors during the 1920s. GM's "car for every purse" strategy had not addressed an important question: Why should an owner trade in a perfectly good car for a newer one? The answer that GM found to stimulate replacement purchases was the introduction of new models each autumn. The limitation on the growth of replacement sales in GM's "car for every purse" strategy was that not every motorist could climb the "ladder of success." Because the ladder was actually a broad-based pyramid (see chapter 7), most Chevrolet buyers remained Chevrolet buyers. Just as in American society few factory workers became foremen, and few accountants became executives, few Chevrolet buyers became Cadillac buyers. Why should Chevrolet owners who were not upwardly mobile give up their perfectly good Chevrolets for newer ones? And if households climbed to a higher rung of Oldsmobile, Buick, or Cadillac, why dispose of their badges of success?

GM made a deliberate policy decision that its cars should be different from one year to the next. Not only did a Chevrolet have to appeal in a given year to a different class of buyer than a Cadillac, this year's Chevrolet had to be demonstrably superior to last year's. Through planned obsolescence, the annual model change could create customer dissatisfaction with older models in a relatively short time. Advertising the annual model improvements would help GM "to create both consumer satisfaction and consumer desire, and at the same time," according to Alfred P. Sloan.[56] Customers came to expect as a matter of course that this year's Chevrolet was somehow better than last year's.

GM began the annual model change in 1923 and formalized it in the 1930s. GM apologized for introducing the concept and felt the need to justify it in its 1923 annual report to shareholders. After all, Henry Ford believed that the car should stay the same every year, changed only to introduce mechanical improvements, such as a closed top. GM by the 1930s explained the annual model change in terms of safety, economy of operation, and maintenance. Instead of installing engineering improvements as they were invented, GM held them back for introduction with fanfare on the new year's models. If engineering improvements were trivial, the company emphasized cosmetic differences instead. The point was to make sure that this year's model had tangible features that could be clearly advertised as different from last year's model.

GM perfected the annual model change in the 1950s. Dealership windows were covered until the official unveiling day. Sneak previews were offered during the summer on Atlantic City's Steel Pier and at a handful of other resorts. A Motorama traveled around the country to display all of the company's products together.

Despite GM's revival of the annual model change during the 1920s, seasonal variations in sales were no longer significant. During the second half of the twentieth century, sales peaked at perhaps 27 percent of the annual total in the spring and dropped to perhaps 22 percent in the winter.[57] The main reason for the flattening of the annual cycle in the 1920s was the introduction of vehicles suitable for winter operation. Previously, nearly all motor vehicles had been open convertibles, which left motorists exposed to harsh winter weather in the large cities of the Northeast, where most vehicles were then sold. Closed cars—with permanently attached wood or metal tops—made up only 2 percent of sales during the 1910s, and were mainly sold to wealthy individuals with chauffeurs or to physicians requiring all-weather vehicles for house calls. Closed cars rapidly gained popu-

larity during the 1920s, accounting for 48 percent of sales in 1924 and 72 percent in 1926. A closed car cost 30–50 percent more than an open car during the 1910s, but only about 5 percent more during the 1920s.[58]

Paying For Production Costs. Manufacturers also demanded cash from dealers to help pay for production costs. According to the Curtis study, "[I]n the beginning people with real capital hesitated to take up this new and uncertain industry and it was left largely to the exploitation of those without substantial resources." The report noted, howere, that "this early lack of capital was not wholly without compensation; one manufacturer declared that if he had started with $100,000 he would have failed. The fact that he had but $25,000 and had to strain every nerve to make ends meet, he said, enabled him to succeed."[59]

To raise the necessary capital, a manufacturer received a line of credit from a bank enabling it to borrow money for immediate operating expenses, such as wages and materials. To conserve scarce funds, a manufacturer bought as many parts as possible on thirty-day or sixty-day "open accounts" from outside suppliers, such as foundries, metal workers, and wood workers. Revenues to pay off suppliers, banks, and other creditors came from the sale of finished vehicles to dealers.[60]

Manufacturers shipped vehicles to dealers with "sight drafts against bill of lading" attached—essentially CODs that required dealers to pay the manufacturers cash before taking possession of them. Financially strapped car makers could get their hands on cash sooner by sealing finished vehicles in railroad cars as soon as they were manufactured and using the attached sight drafts to borrow more money from banks. The manufacturer was kept afloat financially because "as soon as a car was assembled it could be loaded on a flat car, a sight draft attached to bill of lading and discounted at the bank."[61]

Late delivery of parts could mean financial disaster for manufacturers. According to the Curtis report, "[I]f any parts failed to arrive on schedule time the shipment of the car was delayed for no car can be forwarded until the last pair of mud-guards is in place." The Curtis report said that to stave off bankruptcy, car makers would load trains with junk, attach sight drafts stating that the train contained new vehicles destined for a distant dealer, borrow money from banks against the sight draft, and replace the junk with finished vehicles when the missing parts arrived. The Curtis study concluded, "when such financing was not uncommon, it was but natural that men with real capital hesitated to enter the competition. . . . Few

bankers, especially outside of Detroit, were willing to risk capital in the industry." On the one occasion when eastern bankers did participate in an automotive transaction of magnitude—the refinancing of General Motors in 1910—they exacted the most stringent terms.[62]

Dealers could afford to "stake" manufacturers because they faced much lower costs of doing business than contemporary dealers in two main respects. First, because half of all vehicles were sold in the spring, early dealers did not have to pay the salaries of a sales force through the entire year. They could hire salespeople in the spring and lay them off in the fall. Second, early dealers did not have to carry a large inventory of vehicles purchased from manufacturers but not yet sold to the public. Because consumer demand was so high, an early dealer sold every vehicle before even receiving it from the manufacturer. Inventory consisted of at most one demonstrator model, so that customers—most of whom had never been behind the wheel—could learn to operate it and take a test drive while awaiting delivery of their own vehicles.

Not only were early dealers free of the expense of carrying charges on inventory, they also could collect substantial deposits in advance from people eager to get their hands on vehicles as quickly as possible. Dealers turned over to the manufacturers deposits of 2 percent, 5 percent, or 10 percent of the purchase price initially as a way to beg for more cars. Manufacturers started to demand deposits from some dealers, especially those with weaker financial credentials, and these deposits became an important source of working capital for financially strapped manufacturers.

The Curtis study explained how a fledgling producer would use the deposits. Although intending to build only 1,000 cars, a manufacturer would collect 3,000 deposits from dealers, because many customers would back out during the several-month wait for delivery. The $300,000 worth of deposits, as well as the original working capital, would be deposited in the bank.

Customers placing deposits of $100–$250 were not even assured of receiving vehicles. Because so many people were clamoring for cars, dealers could collect deposits for more vehicles than they could actually obtain from the manufacturers. Customers in turn placed deposits with several dealers in the hope that at least one order would actually be filled. Customers considered themselves lucky to get any vehicle at all, and did not much care which model they actually ended up buying.

Dealer-Customer Transactions

Customers lucky enough to receive vehicles paid dealers the cash balance minus deposit at the time of delivery. In view of the unreliability of early vehicles, manufacturers and dealers feared that dissatisfied customers would return their damaged goods and demand their money back. And given the rapid depreciation in the value of their fragile possession, customers might refuse to make the final installments on something that had lost all of its value.[63]

R. E. Olds "explained to his agents that it was also to their advantage to get their money when they delivered the cars. Then the purchasers, he pointed out, would be more careful how they used the cars; they would not run them into the ditch when something went wrong and telephone the agent to go get the car."[64]

The Curtis report noted that "the attitude of the banks toward extending credit for the purchase of automobiles has in general been one of hostility."[65] A principle of sound banking was to promote thrift, so bankers were reluctant to extend credit for what they considered an unwarranted purchase that encouraged extravagant living. Middle-class Americans who aspired to car ownership were advised by bankers to work harder and save their money until they had enough for a cash purchase.

Henry Ford agreed with the bankers. He encouraged potential customers to open savings accounts and wait until they could pay cash rather than borrow. In the 1920s GM overtook Ford as the best-selling car maker—and, more important, as the most profitable car maker—in large measure because it offered its customers credit.

Time payments had long been offered to consumers for purchasing durable goods, such as sewing machines and pianos. Early cars, however, were not considered durable because the rapid depreciation in their value made them worthless before the loan was repaid. Exceptions were made for people purchasing vehicles for business use. The Curtis study noted, "There is no apparent opposition on the part of the banks to the buying of automobile trucks in the cities for they are conceded to be a legitimate part of business equipment." Farmers were also extended credit. "It seems justifiable to loan money to farmers to the purchase of automobiles on the ground that to the farmer an automobile is almost a necessity. He must have some method of transportation to the city, and it is as good business policy for him to buy an automobile as to buy a horse and carriage."[66]

Given the hostility of bankers, dealers during the 1910s began to offer time payments directly to customers. Typically, a customer made a down payment of 66–75 percent of the purchase price; for the balance he gave the dealer two promissory notes, one maturing in three months and the other in six months from date of purchase. Several finance companies experimented with automotive loans during the 1910s, including John L. Little (later National Bond and Investment Company), Henry Ittleson (later Commercial Investment Trust), and A. E. Duncan (later Commercial Credit Company).[67] Despite Henry Ford's opposition to borrowing, 65 percent of Model Ts were purchased in 1919 on credit offered by financial institutions.

Installment purchases soared during the early 1920s. The percentage of car sales financed with loans increased from 29 percent in 1920 to 75 percent in 1924. Farmers Loan & Trust Company estimated the value of auto loans at $2.2 billion in 1924. In 1925, 64 percent of new cars were sold on installment, and nearly all used cars.[68] Alarmed at the explosion of credit, an organization of lenders, the National Association of Credit Men, passed a resolution in 1924 opposing growth of auto credit sales, but it had no effect on the American buying public.

Finance companies reduced down payments to 40–50 percent of purchase price during the early 1920s and to 20–33 percent during the mid-1920s, with some as low as 10 percent. Repayment time was extended from eight or ten months in the early 1920s to twelve or sixteen months, and sometimes eighteen months, in the mid-1920s. With the failure of several finance companies, and with repossession rates running about 2 percent in 1925 and 1926, most dealers and finance companies adopted terms of 33 percent as the minimum down payment for a new car and 40 percent for a used car, with twelve months as the maximum period for repaying the loan.[69]

The widespread availability of credit in part reflected the maturity of the product, which by the 1920s was sufficiently reliable and durable to offer a reasonable expectation of lasting the life of the loan. Credit also stimulated sales, because most of the financed vehicles were low-priced models, reflecting the extension of sales to people who otherwise couldn't afford to buy at all. The concept that a car was something to save for was swept away, replaced by the concept that a car was something that could be easily purchased on credit by anyone.

General Motors established the General Motors Acceptance Corporation (GMAC) in 1919 to meet the growing demand for credit. GMAC ex-

tended credit to dealers to carry inventories and to consumers to cover new car purchases. In the first year GMAC approved $2 million worth of loans. Further stimulating sales, GMAC took customers' used cars as trade-ins. GM advertisements urged Americans to finance their new car purchases: "The automobile is the outdoor home of the modern family. . . . General Motors believes that the same plan, by which a majority of American homes have been financed by their owners, is and should be applicable to the purchase of a car."[70]

GM also established an insurance company, General Exchange Insurance Corporation (GEI), which offered new car buyers low-cost fire, theft, and later collision coverage. Insurance helped GMAC capture 40 percent of GM dealers' financing business by 1926. GEI later required that repair work be done by a GM dealer, giving dealers an important source of revenue. Meanwhile, Ford waited until 1928 to form a credit agency, Universal Credit Corporation, which was an independent business rather than a Ford subsidiary. Ford did not establish its own in-house financing arm, Ford Motor Credit, until the 1950s.

Ownership of motor vehicles exploded during the 1920s when the ability to purchase on credit was extended to most Americans. The famous humorist Will Rogers said that America was the first nation in the history of the world to go to the poorhouse in an automobile.

10 . . . *To Serving Customers*

> The baby boomers discovered health clubs and plastic surgeons. Buying S.U.V.'s to match their Timberlands and 501 Levis fits a vain and image-conscious generation.
>
> —Christopher W. Cedergren, president, Nextrend, a marketing research company

In 2000 AutoNation was the largest group of dealers in new and used cars in the United States, with 282 dealerships around the country. AutoNation dominated motor vehicle sales in several major markets, especially south Florida (where the company's founder, H. Wayne Huizenga, lived) and Denver, where AutoNation bought several dealerships owned by the city's long-time star quarterback, John Elway.

When AutoNation was founded in 1996, the country's two largest dealer chains, Hendrick Automotive Group and Potamkin Companies, had sixty-seven and fifty-seven dealerships, respectively, and the third-largest chain had only twenty-seven. AutoNation recorded sales of $5 billion in 1996, $10 billion in 1997, $15 billion in 1998, and $21 billion in 1999; in 1995 Hendrick had been the only dealership chain to sell even $2 billion worth of vehicles. AutoNation sold 902,000 new and used vehicles in 2000, compared to 105,000 sold by Hendrick back in 1995.

Before founding AutoNation Huizenga had made a fortune transforming the nation's garbage-hauling and movie rental industries, and he thought he could apply similar business practices to selling motor vehicles. The son of Dutch immigrants who ran garbage-hauling companies in Chicago, Huizenga got into business by buying a garbage truck in Miami, Florida, in 1962, with $5,000 borrowed from his father-in-law; he built a successful hauling company, Dumpster by Dumpster. Four years later he started Waste Management Corporation, which bought up small haulers around the country. Huizenga sold the company in 1984 for $3 billion.

Huizenga bought Blockbuster Video in 1987, then a chain of 19 video rental stores, built it into a chain of 3,700 stores, and sold it in 1994 to Viacom for $8.4 billion. He put some of the billions into buying three Miami-based major league sports franchises: the Miami Dolphins of the National Football League, the Florida Panthers of the National Hockey League, and the Florida Marlins of baseball's National League. He spent lavishly to acquire enough talent for the Marlins to win the World Series in 1997, only to dismantle the team the following year by selling off most of the stars, because he didn't make enough money from it.

Huizenga planned AutoNation as a vertically integrated empire covering all aspects of motor vehicle sales and service. To sell new vehicles, AutoNation retained most of the existing names of the dealerships it acquired. Late-model used vehicles were sold at newly established stores carrying the AutoNation name. The company also sold older, less expensive used cars at stores called ValuStop. A centralized inventory of the company's 90,000 vehicles for sale around the country was maintained on the Internet. AutoNation also acquired two rental companies: National, which competed with Hertz and Avis for business customers, and Alamo, which offered lower prices for leisure travelers. It set up a finance company that offered leases to buyers at any of the new or used car stores. AutoNation's reconditioning centers made mechanical and cosmetic repairs for all of the company's vehicles, regardless of where in the empire they would be next sold or leased.

Shares in AutoNation were offered to the public, and the trading price quickly rose, reaching more than $40 a share by the end of 1996. Then the bubble burst. In the midst of Wall Street's record bull market, AutoNation shares dropped to $8 a share in late 1999. Belatedly the company closed some of its stores, sold assets, and laid off workers.

How vehicles were manufactured changed dramatically in the late twentieth century. How vehicles were sold changed remarkably little. Vehicles reached customers in 2000 the same way as in 1950, through thousands of small, independently owned, franchised dealers. At the start of the twenty-first century dealers belatedly faced changes that had swept the rest of the auto industry.

Manufacturers instigated most of the late twentieth-century changes in the motor vehicle industry. Lean production, vertical disintegration, and reskilling labor changed the way vehicles were built, and the fragmentation and segmentation of the marketplace changed the way vehicles were designed. Manufacturers were responsible for reducing production costs

and increasing quality of the vehicles. The sales system was scarcely affected by the upheavals of the late twentieth century. But the buying experience seemed likely to become very different during the twenty-first century. Whether AutoNation was the pioneer in the sales revolution, or just a false lead, was still unclear in the first years of the twenty-first century.

The Branding Battle

The battle to sell motor vehicles that AutoNation entered in the late 1990s focused on how best to brand the product. Most major consumer products, such as household appliances and electronics, had become clearly branded in one of two ways. Some people set out to purchase a particular brand of appliance, such as a Maytag dishwasher or a Sony television, and searched for a store that sold that brand, perhaps by consulting newspaper advertisements or a telephone directory. Others set out to purchase the product at a particular brand of store, such as Sears or Circuit City, known for convenient locations, low prices, wide selection, and good service. Arrayed next to each other in the store were many competing models, with prominently displayed prices, and the consumer took home the one that appeared to offer the most features for the money.

With motor vehicles, branding remained blurred in 2000, as equal prominence was given to the brand of product and brand of store, such as Jones Chevrolet or Valley Honda. The blurring was inconsequential in the 1950s, when the choice of products in a particular price range could be counted on one hand. In 2000, when most market segments had at least a dozen competitors, consumers were unable to go to just one store to compare prices and features, as they could do with other major appliances. Placing two brands of product side by side to compare features was rarely possible with motor vehicles, because competing products were sold at different stores. Comparing two products on the basis of price required negotiating with salespeople at more than one store. Even consumers who had settled on just one brand of product had to visit several stores to compare prices, which could vary widely. Moreover, consumers found out prices not by examining a sticker but only through lengthy haggling with salespeople. Unlike other major appliances, the brand of motor vehicle was the same nationally, but the brand of store changed in every community. A newcomer to a community had to shop without knowing the merits of the various dealers.

Branding Stores or Branding Products?

The traditional blurring of brands in selling motor vehicles through local dealers was attacked from two fronts. On one side, retailers such as AutoNation sought to sell motor vehicles by brand of store. On the other side, manufacturers such as Ford sought to sell motor vehicles by brand of product. Many traditional dealers that had blurred the brand of product and brand of store succumbed to the two-pronged assault and went out of business in the late twentieth century, but others fought back successfully. And lurking behind the mass-retailers, mass-producers, and traditional dealers in 2000 was an even greater uncertainty in selling motor vehicles—the growth of the Internet and e-commerce.

AutoNation was designed to revolutionize the sale of motor vehicles by creating a national brand of store, as had long ago occurred in other retail sectors. Mass-retailers, such as Wal-Mart and Home Depot, had reduced inefficiencies in the distribution of many products through consolidation of overhead and volume purchasing. More efficient operations brought lower prices, which generated greater customer traffic, which in turn justified offering a very large selection. Before creating AutoNation, Huizenga had used similar methods to brand Blockbuster Video as the nation's leading chain of video rental stores.

AutoNation began by branding its late-model used car stores. By establishing identically branded used car stores throughout the country, AutoNation hoped to generate the sort of recognition for service and selection that companies such as Wal-Mart, McDonald's, and Blockbuster Video enjoyed in other retailing segments. AutoNation's "used car lot" was called the "outdoor display area," and instead of a "deal" the store made a "transaction." AutoNation stores sold snacks, auto supplies, t-shirts, and caps, and offered a supervised playroom for shoppers' children.

Customers reviewed the store's large inventory on a touch-screen computer, printed out data and pictures of attractive vehicles, and roamed the outdoor display area either by themselves or in a golf cart with a sales guide, as they preferred. Sticker prices were firm and not subject to bargaining. Savvy customers might find similar vehicles for less money elsewhere, but AutoNation spent more to refurbish the vehicles and offered a more generous warranty than other used car dealers. By sharing advertising, inventory, interest charges, and reconditioning costs across the large volume, AutoNation hoped to trim $1,000 from the average cost of a used

car. Circuit City's CarMax had developed a similar concept for selling used cars in 1993, three years before AutoNation.[1]

AutoNation also hoped to establish a nationally uniform name for new car stores. Because all of its new car stores were acquired rather than started from scratch, AutoNation chose to retain the existing store names, which already had high consumer recognition in most markets. The company intended to use both the existing store name and AutoNation as a transition—for example, "John Elway's AutoNation Ford" in Denver.

Manufacturers opposed AutoNation's attempts to brand stores, arguing that motor vehicles already ranked among the most highly recognized brands in any retail segment. The most ambitious challenge to AutoNation was made by Ford Motor Company. Ford launched a plan to consolidate all of its dealers into one organization in major metropolitan areas where the company's market share was below its national average. Legally prevented from compelling dealers to consolidate, Ford convinced its dealers in Tulsa, Oklahoma, to form Tulsa Auto Collection in 1998. Ford dealers in Oklahoma City, Salt Lake City, and Rochester, New York, also agreed to consolidate in 1999.

Before consolidation, Tulsa had six Ford Division dealerships, plus two Lincoln-Mercury dealerships owned by two of the Ford Division dealers. Ford's market share in Tulsa was close to the national average for trucks, but a couple of points below the national average for cars. After consolidation, the owner of one of the dealerships, Don Thornton, became CEO of Tulsa Auto Collection. One of the eight dealerships was closed.

The principal cost savings from consolidation came from advertising. By sharing advertising, the Ford dealers cut their collective annual expenditure from $6 million to $3.5 million. Another $1 million was saved in other areas, primarily salaries. Combined payroll was cut from 1,000 to 960, but most of the savings in this area came from lower insurance rates, because of the much larger pool of covered employees. And employees received broader insurance coverage. With Ford selling 20,000 vehicles annually in Tulsa, the $3.5 million savings worked out to $175 per vehicle.[2]

Traditional Dealers React

Traditional dealers competed with superstores and manufacturer-owned outlets by selling more vehicles at lower profit margins, and by offering more attractive sales and service experiences. Consolidation—discussed in chapter 2 as a major trend for motor vehicle manufacturers during the 1990s—also hit the sales side of the industry. The number of dealerships in

the United States declined by more than one-half during the second half of the twentieth century, from 46,821 in 1950 to 22,004 in 2000.

Most of the mortality among dealerships predated the challenge mounted by superstores and manufacturers during the 1990s. The sharpest reduction in dealerships came in the 1950s, when the number declined by 22 percent, to 36,336 in 1960. The drop in the 1950s resulted primarily from the withdrawal from the market of several small manufacturers, such as Hudson, Nash, Packard, Studebaker, and Willys. The number of dealerships declined by 18 percent during the 1960s, 11 percent during the 1970s, 13 percent during the 1980s, and 12 percent during the 1990s.

The number of dealers handling Ford Motor Company vehicles declined 38 percent; GM dealers, 47 percent; and Chrysler Corporation (excluding Daimler-Benz) dealers, 59 percent. From the 1950s through the 1980s, the loss of Big Three dealers was partially offset by an increase in the number of dealers handling imported vehicles—from a handful in the 1950s to a peak of 5,408 in 1988. The number of import dealers declined 5 percent during the 1990s, to 5,073 in 2000.

Surviving dealers sold many more vehicles in 2000 than they had in the previous fifty years. The number of vehicles sold by the average dealer in a year increased from 150 in 1950 to 200 in 1960, 330 in 1970, 400 in 1980, 560 in 1990, and 770 in 2000. The large increase in annual sales per dealer came from halving the number of dealers and doubling the level of annual sales.

Although the decline in the number of dealers started back in the 1950s, a new factor in the 1990s was a sharp decline in the number of companies owning the dealerships. Nearly all of the 47,000 dealerships in 1950 were small businesses owned by individuals who held one franchise to sell one brand of vehicle in their hometowns. Even in 1990 the country's 25,000 dealerships were owned by 16,300 companies, so most dealers still owned only one store. Most of the two- or three-store owners had added one or two foreign car outlets to their Big Three dealership during the 1970s and 1980s. But while the number of dealerships declined 12 percent in the 1990s, to 22,000, the number of owners declined more than 50 percent, to 8,000.

Dealers needed to become much larger during the 1990s because of a sharp decline in net profit per vehicle. Dealers had been accustomed to earning a net profit after expenses of around 5 percent per vehicle during the 1950s and 1960s, far less than the 20 percent or more enjoyed during the industry's pioneering days, though enough to make a comfortable living.[3] But the average net profit per vehicle eroded to under 2 percent dur-

ing the 1990s.[4] Dealers earned 20 percent gross profit per sale during the 1950s, from which they spent 15 percent on expenses, leaving a net profit of 5 percent. Dealers had become more efficient by 2000, when expenses amounted to more than 11 percent, while gross earnings per sale declined to less than 13 percent, leaving a net profit of less than 2 percent.

The fewer and larger surviving dealers also competed by offering a better sales and service environment for customers. Dealers provided more than 90 percent of service covered by a manufacturer's warranty, but once the warranty expired and customers had to pay for the work, the dealers were unable to retain many of their customers. Garages unattached to a dealership performed one-third of repairs and one-half of routine maintenance, such as oil changes.[5]

In response to satisfaction surveys, service departments kept extended evening and weekend hours, explained problems and options more clearly, gave customers rides to and from the shop, completed work when promised, and of course actually fixed the problem correctly the first time. To detect problems in late-model vehicles, dealers invested in elaborate diagnostic equipment. Dealers sought to improve the service portion of their operations because it contributed an increasing percentage of their profits. A dealer has three principal ways to generate revenue: sell new vehicles, sell used vehicles, and provide service. Service contributes the lowest percentage of the three areas to the average dealer's revenues, but the highest percentage to profits.

The sale of new vehicles accounted for about 60 percent of the average dealer's revenues during the second half of the twentieth century; the sale of used vehicles, 25 percent; and service, 15 percent. The relative contribution of the three to overall dealer revenues did not change much in that period: used vehicle sales increased from 25 percent to 30 percent of overall revenues between 1950 and 2000, and the other two areas each declined by a few percentage points. A greater shift occurred in the distribution of profits among the three areas. Between 1950 and 2000 new vehicle sales decreased from 40 percent to 30 percent of profits, used vehicle sales increased from 20 percent to 25 percent, and service increased from 40 percent to 45 percent.

Surviving dealers also made the sales environment less intimidating. Most Americans viewed buying a car as the equivalent of visiting the dentist—a procedure sure to inflict pain but necessary for long-term personal comfort. Consumers despised the high-pressure sales pitch, the complicated price negotiations, the broken promises after a salesperson con-

sulted a supervisor. Because they were about to spend more to buy a car than they would to purchase any other product, consumers felt ill at ease even before they walked into a showroom, and the intimidating environment did nothing to relieve the situation. Customers wanted to be greeted courteously and served by knowledgeable sales agents who kept their promises.

Despite the loss of one-half of dealers during the second half of the twentieth century, customer satisfaction with dealers rose only slightly. According to a manufacturer's survey during the 1990s, one-third of customers found the sales environment too pressured and one-half found sales agents insufficiently knowledgeable.

Trickier to assess was whether fixed pricing or negotiating affected customer satisfaction with dealer performance. In the early years of the industry, a buyer generally paid a fixed price for the vehicle, which was set by the manufacturer and publicized in nationwide advertisements. Dealers advertised prices and actually sold vehicles at those prices, because customers viewed price cutting as a rather shady practice.[6] The haggling over a final selling price—so familiar to customers in the late twentieth century—did not become widespread until the 1950s.

When the U.S. auto industry consolidated into a handful of manufacturers after World War II, the Department of Justice and Congress raised concerns about monopolistic practices, including fixed pricing. The Justice Department threatened to apply the 1890 Sherman Anti-Trust Act to motor vehicle sales. The Sherman Act viewed as an unlawful restraint of trade a contract in which a buyer (such as a car dealer) was obligated to resell (to a customer) at a price fixed by the seller (such as a manufacturer). The 1956 Good Faith Act specifically prohibited price fixing between manufacturers and dealers of new cars.

In response, manufacturers stopped advertising fixed prices and instead provided dealers with *suggested* retail prices. Free to set their own prices, dealers presented customers with so-called list prices, derived by substantially increasing the manufacturers' suggested retail prices through a practice known as "price packing." Price packing had four main components:

1. To the invoice price paid to the manufacturer, a dealer typically added a 33.3 percent markup during the 1950s, ostensibly to cover increases in such operating expenses as freight, advertising, and warehousing, which in the past had been passed on to the customer without retail markup.

2. Claiming that the one-third markup still did not cover operating expenses, the dealer added an additional delivery, handling, and service charge of about 10 percent.
3. Some dealers added yet another markup of several percent in pure gross profit to reach the so-called "list" price shown to the customers.
4. Dealers began to order all of their vehicles from the factory equipped with accessory packages that could be resold to customers at higher markups, and some accessories were installed locally at even higher markups.[7]

Customers in the 1950s did not immediately realize that dealers were no longer selling new cars at prices fixed by the manufacturers. Once customers understood this, they started to shop around for the best prices on new cars, as well as trade-in allowances. Dealers responded by advertising greater discounts on new car prices, while raising the price pack to offset the discount.

The Monroney Price Label Act, effective with 1959 models, required that the manufacturer's suggested retail price be displayed on the driver's side rear window. The sticker had to show the vehicle identity number (VIN), the equipment and features included in the base price of the vehicle, the suggested prices for optional equipment and dealer preparation, and the destination charge. In later years additional information was required on the sticker, including the North American plant where the vehicle was assembled or the port where the vehicle entered the United States, the percentage of U.S. and Canadian parts, the country of origin of the engine and transmission, and the EPA fuel economy ratings for city and highway driving.

The Monroney Act curbed the worst excesses of price packing. Identically equipped models at two showrooms now carried the same manufacturer's suggested retail price. But price packing was not dead, because a dealer could add a line to the sticker price, often called "dealer preparation," that was substantially higher than the actual cost of readying the vehicle for the buyer to take possession.

A handful of dealers experimented with fixed prices during the 1990s. Most notable were stores selling Saturn vehicles. When GM's Saturn Corporation started selling vehicles in the 1991 model year, it differentiated its product from long-established competitors by setting a fixed and nationally advertised price. Customers understood that the sticker price was the

actual price that would be paid, with no negotiations or hidden price packs. The only additional charges were for taxes and licensing fees.

Freed from the pressure of negotiating price, Saturn sales agents could concentrate on customer relations. Agents greeted customers warmly and courteously, without a hint of pressure. Knowledgeable about the products they were selling, agents offered to explain features of the vehicles, but consumers who wished to look around on their own were free to do so. New owners were escorted out of the showroom by a chorus of all sales agents singing and applauding.

Saturn laid the groundwork for the positive buying experience through two key decisions. First, the company decided to award a much smaller number of dealer franchises than other brands. That way, the number of sales per dealership would be high; in fact, the average Saturn dealer during the 1990s sold more cars than any other dealer, although the average Toyota dealer sold more vehicles when car and truck sales were combined. Each Saturn dealer in turn was free to open as many stores in the franchise area as it wished, perhaps one on the north side of town and one on the south side.

Saturn's second key decision was to award the franchise to the dealer with one of the highest customer satisfaction ratings in the market area. By bringing together an exclusive club of high-quality dealers, Saturn was able to create a consistently positive buying environment for consumers throughout the country. A team of independent dealers joined Saturn sales and marketing executives, regional managers, and UAW members to make decisions concerning Saturn's marketing strategy.[8]

Some dealers selling other products also abandoned haggling during the 1990s. Some advertised a fixed price, such as "$49 over invoice." Others offered all customers the same reduction from the manufacturer's suggested retail price. But most dealers stuck with the familiar bargaining atmosphere, and most consumers seemed to prefer it. Fixed pricing cost AutoNation a lot of sales. Shoppers took AutoNation's fixed price to a dealer willing to negotiate a lower price. Traditional dealers could undercut AutoNation because they had lower overhead and administrative costs, and they could pad their profits on vehicles sold to poor negotiators.[9]

The shape of the automotive retail environment was so uncertain at the start of the twenty-first century that evidence concerning the best way to sell vehicles seemed contradictory. Some customers clearly disliked haggling over price, and were attracted to Saturn and fixed-price dealerships.

Other customers enjoyed the give and take of haggling and believed that their bargaining skills were rewarded by lower prices.

Growth of the Internet

Looming behind the battle between large companies and small independents, and between fixed pricing and haggling, was the Internet, which quickly gained a major role in motor vehicle sales. In 2000 its precise role was still uncertain: would it be primarily a source of information, or a method of purchasing?

As a source of information, the Internet had already changed buying habits by 2000. Half of new vehicle buyers consulted World Wide Web sites before making their purchases. Automotive advertising on Web sites increased from $10 million in 1996 to $90 million in 1999, although it still represented only 1 percent of the industry's $8 billion total advertising budget that year. Consumers could research features, options, and specifications to help them decide on the particular nameplate and model to purchase.

More important, the Internet offered customers much more pricing information than had previously been available. Once, buyers did not know how much a dealer paid a manufacturer for a vehicle, and therefore how much profit had been packed into the sticker price. Consumer-oriented magazines, such as *Consumer Reports,* offered readers some assistance in calculating the dealer's markup. Readers unsure of their arithmetic skills could purchase detailed calculations for specific models from the magazine. Suddenly the Internet reduced the dealer's negotiating advantage, when invoice and sticker prices for every model were listed on Web sites, first by independent companies and ultimately by the dealers and manufacturers themselves.

Similarly, dealers historically consulted one of a handful of directories, such as *Kelley Blue Book,* to set the trade-in allowance on a used car or the sale price on the used car lot. To obtain the Blue Book value of a currently owned vehicle or one for sale by a dealer, a customer had to convince a friend at a bank or dealership to sneak a peak at the directory. Here again, the current buying and selling value of any older vehicle became easily accessible to consumers once listed on a number of Web sites, including one operated by *Kelley Blue Book* itself.

While more than half of all buyers in the United States were conducting research on the Internet in 2000, only 1 percent were willing to purchase a motor vehicle that way. The limited use of the Internet to sell vehicles re-

sulted in part from the understandable hesitation of consumers to conduct a costly transaction in an unfamiliar buying environment. But obstacles to using the Internet stemmed from more than unfamiliarity.

The first distinctive problem with selling motor vehicles by Internet was franchising laws. As a small business, a dealership was restricted to selling in a delineated franchise area and protected from encroachment by dealers based in other market areas. Thus, a dealer in Salt Lake City was not permitted to advertise in a newspaper or on a television station in Denver, and at the same time was protected from incursion by a Denver dealer. Dealers feared that to save a couple of hundred dollars, a customer might be willing to purchase by Internet from a dealer in another franchise area and then travel a few hundred miles to pick up the vehicle. Dealers in small towns or rural areas with relatively low costs of doing business, such as rent and salaries, might be especially well placed to take advantage of Internet sales at the expense of big-city dealers.

A second concern was that the Internet might make it possible for a consumer to purchase a vehicle directly from the manufacturer. Manufacturers of computers enjoyed considerable success selling directly to customers by Internet during the 1990s. The ability to order directly from the factory could be especially attractive for customers who wished to purchase a vehicle with a distinctive combination of options and features. By responding to direct customer orders, the manufacturers would not have to tailor production to their best guesses concerning consumer preferences. But direct factory ordering would put many dealers out of business. Placing the dealer—a small business—at a competitive disadvantage against the manufacturer—one of the world's largest corporations—has so far been politically impossible in the United States.

Consequently, buying a vehicle on the Internet in 2000 was a cumbersome process. First, a potential customer logged on to a manufacturer's, dealer's or independent Web site and filled out an electronic form expressing willingness to purchase a particular brand and model of a vehicle. This interest was communicated to dealers in the customer's market area. Dealers had the option of ignoring the request or offering models that matched the customer's specifications. The customer then could choose to complete the transaction with one of the responding dealers.

The Internet approach did not offer a fundamentally different way of purchasing a vehicle. The independent, small-business dealership remained at the heart of the transaction. The Internet was attractive mainly to people who sought to avoid haggling in the dealer showroom, especially

minorities and women. The Internet approach worked well for consumers who knew exactly what model and equipment they wanted. The Internet failed to substitute for the "fun" and "excitement" that many people experienced in purchasing a new vehicle—the comparison of competing models, the test drives, the "new smell" of a brand-new vehicle, the "playing" with all the features, the arrangement of the seat in a comfortable position. Unless the motor vehicle became a generic transportation commodity, actual shopping with a personal sales assistant would remain the major method of purchase.

Serving Different Needs

Consumers don't particularly care how they buy their vehicles. They want to buy from people who understand their needs and treat them with respect. The challenge for retailers is to serve the needs of consumers sensitively and knowledgeably—but this can be difficult, since today's consumers vary widely in their needs and preferences. Dealing cars was an occupation for white, middle-aged, family men for most of the twentieth century. Nearly all dealers used to fit this description, and so did nearly all their customers. Most buyers and sellers relished the battle over fixing the price. The buyer brought in his wife to veto extravagant temptations, and the seller brought in his boss to veto excessively low offers. But by 2000 white, middle-aged, family men represented only a small percentage of the customers who walked into dealerships. Many customers, including women, African Americans, young people—and some middle-aged white men—were repelled by traditional dealer tactics, and they could take their business elsewhere, even to the Internet.

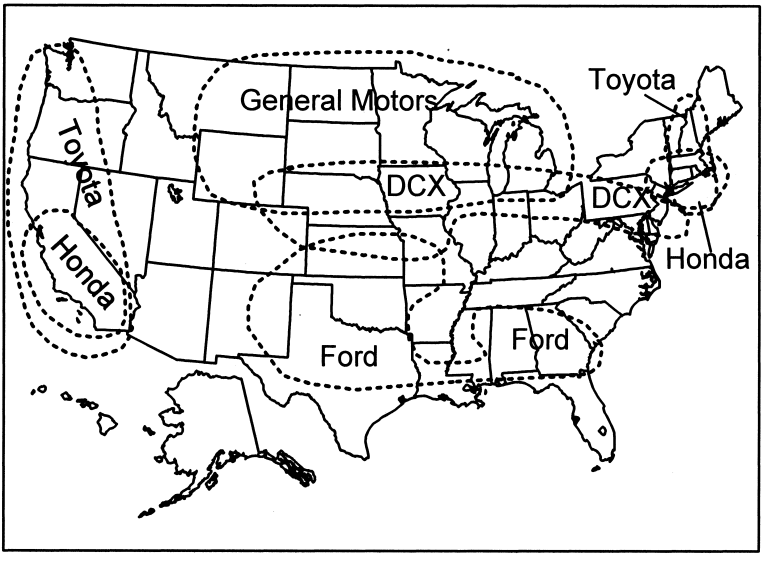
Serving Needs in Different Regions

The United States may be the world's largest vehicle market, but in reality the country is divided into many local markets. To serve customers effectively, a dealer in one region of the United States must stock a very different selection than a dealer in another region. Other national retailers must also deal with local variations, of course: Wal-Mart sells few mittens in Florida or shorts in Maine (at least in winter). But given that an automotive dealer completes far fewer sales than Wal-Mart—perhaps fifty in a good month—the dealer must be very careful to stock vehicles attractive to local customers. Vehicles sitting on the lot unsold are the biggest drain on a dealership's profitability.

The United States in 2000 was divided into two broad market areas: the interior and the coasts. In general, trucks outsold cars in interior states, and domestic nameplates held relatively large market shares there, while in coastal states cars outsold trucks, and foreign nameplates did relatively well. These broad patterns masked differences among individual companies.

GM's principal strength was in the upper Midwest (Fig. 10.1). The company sold more than 40 percent of the vehicles in Indiana, Iowa, Michigan, Minnesota, North Dakota, South Dakota, and Wyoming. On the other hand, GM held less than one-fourth of the market on the west coast (only one-fifth in California) and in the Northeast.

The two best-selling Japanese nameplates, Toyota and Honda, displayed similar national distributions. Both had relatively low market shares in the interior and high market shares along the East and West Coasts, especially in California—essentially the reverse of GM's pattern. The two nameplates together held 18 percent of the car market in the country as a whole in 2000, and 30 percent in California. Honda cars outsold Toyota cars in all but a handful of states west of the Mississippi River, especially on the West Coast. Toyota was stronger in New England and the Southeast, especially Florida.



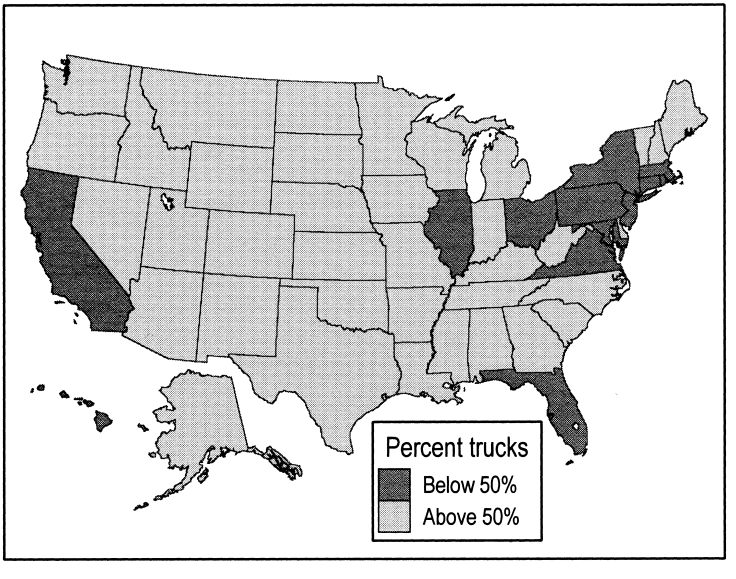
10.1. Market share by manufacturer, 1999. (Calculated from *Automotive News Market Data Book,* 2000)

DaimlerChrysler's strength was in the Northeast, especially for its minivans and sport utility vehicles. Its Jeep nameplate and its minivans combined had about 7 percent of the national market and about 15 percent of the market in northeastern states between Massachusetts and Virginia.

Ford Motor Company sales varied much less regionally than those of the other major manufacturers. Its cars and trucks sold a bit better in the south-central United States, in such states as Texas and Oklahoma. As discussed below, Ford's market share varied more dramatically by gender than by region.

Trucks outsold cars in 2000 in thirty-seven of fifty states, and exceeded 60 percent of the market in Alaska, Arkansas, Idaho, North Dakota, South Dakota, and Wyoming (Fig. 10.2). Cars outsold trucks in eight East Coast states between Massachusetts and Virginia, plus California, Florida, Hawaii, Illinois, Ohio, and the District of Columbia. Cars held more than 60 percent of the market in Connecticut, Florida, Hawaii, Massachusetts, New Jersey, and Rhode Island.

Regional differences between car and truck preferences, and domestic and foreign preferences were interrelated, given the relative strength of domestic nameplates in the truck market and of foreign nameplates in the



10.2. Market share for cars and trucks, 1999. (Calculated from *Automotive News Market Data Book,* 2000)

car market. Less clear was the nature of the interrelationship. Did coastal buyers prefer to buy cars and therefore looked at foreign companies that offered attractive car models, while interior buyers preferred to buy trucks and therefore looked at domestic companies that offered attractive truck models? Or did coastal buyers prefer to buy foreign nameplates and therefore gravitated toward cars, while interior buyers preferred to buy domestic nameplates and therefore gravitated toward trucks?

Regional variations may be due to differences in lifestyles. Buyers of sport utility vehicles were especially interested in outdoor activities more likely to be found in the interior, such as camping, boating, fishing, and hunting. Texans, with their preference for anything big, bought one-fourth of the largest sport utility vehicles sold in the United States, such as Chevrolet Suburban.[10] SUVs held one-fourth of the market in Colorado because motorists believed that the vehicles would perform relatively well on icy mountain roads—although a 1995 *Denver Post* study found that 223 of 513 winter accidents on I-70 involved four-wheel-drive vehicles.[11]

Owners of foreign cars were more likely to attend symphonies, wine tastings, and cultural events—activities more common in the large cities of the East and West Coasts. California, where cars were more popular than trucks, was home to the design studios of most Japanese nameplates. Cars that younger Californians found attractive were not especially popular in interior states. Midwesterners had little interest in California's car clubs, low-riders, or low-speed freeway chases.[12]

In some states motorists did shop by nameplate. DaimlerChrysler, Ford, and General Motors clearly benefited from a hometown effect in Michigan, where the three companies held 90 percent of the market, compared to 70 percent nationally. Toyota had a relatively high market share in Kentucky, where it had most of its North American operations, and Nissan and Saturn had relatively high market shares in their "home" state of Tennessee. However, Honda did not get a spike in market share in Ohio, where it was based, nor did smaller foreign companies in their North American "homes."

Serving the Needs of Women

"Women are a greater influence in the automobile buying field than ever before," a high-ranking Ford Motor Company executive told *The New York Times*.[13] According to an *Automotive News* report, "[Ford's] global strategy calls for increased sensibility to women buyers in product development and design, marketing, advertising, training, corporate image and retail-

ing."[14] The first statement was made in 1924 by Edsel Ford, then president of the Ford Motor Company; the second statement came nearly three-quarters of a century later, in 1997.

From the beginning retailers have recognized that women play a major role in most new car purchases. Women were said to influence half of all purchases in 1900; a century later women were said to influence 80 percent of all purchases. But until the 1990s manufacturing executives and dealership owners—virtually all men, of course—viewed women as supporting family members rather than as principal decision-makers.

"A woman's interest is in the appearance and comfort of the car rather than in its mechanical excellence," opined the first major study of the role of women in purchasing cars, conducted by the Curtis Publishing Company in 1914. "The riding qualities of the car, the degree of comfort it affords, is the . . . test that a woman applies in judging a car. . . . A man usually requires the dealer to give his wife a ride in the car, the cushions are tested, and the width of the doors and other arrangements examined."[15]

Women played a greater role in the purchase of cars in the 1920s, because they were doing more of the driving—in many families, most of the driving. Freed from some of their household drudgery by labor-saving devices, such as washing machines and gas stoves, women took on more responsibilities outside the home—things they could do only by driving. In urban areas husbands commuted to work by streetcar, bus, subway, or commuter train, while wives used the cars to drop off children at school, buy groceries, and visit friends and relatives. In rural areas husbands plowed the fields, while wives drove into town to buy household necessities. "Many farmers' wives favor the purchase of an automobile because it helps to break up the isolation of their lives," said the Curtis report.[16]

Early cars were engineered with little consideration for the needs and preferences of women. The cars were difficult to operate, unreliable, and uncomfortable. Cranking the car's starter by hand was dangerous for even strong men and nearly impossible for women. The open, carriage-style passenger compartment offered no protection from mud, soot, and rain (Fig. 10.3).

The electric starter, beginning with Cadillac in 1912, as well as easier steering and more smoothly shifting gears, eliminated physical strength as a requirement for driving. Lower axles and running boards made entry and exit easier. Seats could be adjusted so that shorter drivers could reach the pedals. Closed bodies and cord tires made the ride more comfortable.

THE SATURDAY EVENING POST
150
Women who have been frightened
Women who have been frightened while driving a car with bulky wooden corner posts that hide an approaching car only two seconds away, may feel perfectly safe in the new Jordan Observation Sedan.
The new all steel body makes you feel as if you were riding in an observation car. That's vision.
Besides, it is quiet just as a steel Pullman is more quiet than the old wooden kind. And it's safe.
The new Jordan Line Eight Sedan is the lowest priced eight cylinder enclosed car in America.
New style—new comfort—new economy—great simplicity—the first quality light eight in the market—a new leader among motor cars.
People once thought eights were complicated—but not the line eight. Some thought they were extravagant to operate—not this with seventeen miles to the gallon.
But the wonderful thing is the feeling of smooth, flowing power and great reserve. That's what all experienced motorists love.
Sedan $1845. Playboy $1695.
JORDAN MOTOR CAR COMPANY, Inc., CLEVELAND, OHIO
Prices quoted f. o. b. Cleveland. Add Federal Tax
JORDAN
A marvelous day in late December—a splendid tang in the wintry air—a holiday spirit and a wonderful girl home from school. Well—father has to have a good time—and that's that.

10.3. Jordan, 1926. Jordan Motor Car Company achieved success during the 1920s as the first car maker to mount a sustained advertising campaign appealing specifically to women. (National Automotive History Collection, Detroit Public Library)

In the late 1920s General Motors created an Art and Color section as part of its Fisher Body Division to satisfy the rapidly emerging taste for styling. Styling that appealed to women helped GM pass Ford in sales in the late 1920s and maintain that lead through the decades. One example was the creation of the hardtop in the late 1940s: "The story goes that Sarah Ragsdale, wife of Buick executive Ed Ragsdale, loved the sporty look of convertibles but hated getting her hair mussed by the wind. So she always drove her convertible with the top up."[17]

While women long influenced household decisions about new vehicles, relatively few women purchased cars themselves until the late twentieth century. A woman was the principal decision-maker on one-half of new vehicles sold during the 1990s, compared to one-third during the 1970s.

The increasing responsibility for purchasing vehicles reflected the changing structure of American households. Of the roughly 100 million households in the United States in 2000, about 30 million had at least one adult woman and no adult male. About half of those households consisted of women living alone; the rest, of women living with others, primarily children. In comparison, during the 1950s only about 8 million of the 50 million households in the United States had at least one adult woman and no adult male; those households were divided about evenly between women living alone and women living with children. Thus, the number of households in the United States doubled during the second half of the twentieth century, while the number of households with no adult male nearly quadrupled.

Two-thirds of women were employed outside the home in 2000, compared to one-third in 1950, so women had more financial responsibility for buying vehicles, even in households containing adult males. Earning lower wages than men, women on average spent a higher percentage of household income to buy vehicles, so they were more interested than men in lower prices. Women paid more attention to fuel economy, to minimize not only fuel costs but also frequency of fuel stops. Wishing to save money, and being less concerned with performance, women were more likely than men to choose manual transmissions and the smaller of two available engines.

To assess quality and determine a fair price, women were much more likely than men to ask advice from friends and relatives and to consult consumer-oriented magazines, such as *Consumer Reports*. Before buying, women spent more time than men researching features of various models, especially the vehicle's interior. Because of their smaller stature, women

were more concerned with being able to reposition seats so that they could see out and reach the pedals. They got in and out of cars more often, so they paid more attention to ease of entry and exit, and operation of handles. They wanted roomier trunks and easy-to-close lids and doors.

As a result of weighing factors differently, women did not buy the same vehicles as men. In general, women were more likely than men to buy smaller cars, and less likely to buy trucks. Women accounted for two-thirds of small car buyers, but only one-third of luxury car buyers in 2000, and they accounted for one-half of car buyers, but only one-fourth of truck buyers.

The major beneficiaries of the increasing role played by women in selecting new vehicles were Japanese-owned manufacturers. From the time the Japanese vehicles became major players in the U.S. market during the 1970s, they consistently maintained a roughly ten-percentage-point "gender gap" over U.S.–owned and European-owned brands. Women were responsible for purchasing more than one-half of all vehicles made by Japanese companies during the 1990s, compared to 40 percent of vehicles made by U.S. and European companies. Japanese companies did not consciously set out to appeal more to women, but with women accounting for an increasing percentage of new car buyers in the United States, the gender gap became an asset for the Japanese firms, as their cars were designed with more consideration given to issues of concern to women.

Women were also attracted to Japanese vehicles during the late twentieth century because the sales and service experiences were more pleasant at the dealerships of those brands. Ford and GM dealers were more likely to tell single women to come back with their husbands or fathers, while Honda or Toyota dealers were happy to sell to lone women. By 2000 the differences between dealers of U.S.–made and Japanese-made vehicles were no longer significant, but the damage done in the 1980s by Big Three dealers lingered in many women's minds. Once they had bought a Japanese car and been treated with respect by the dealer, why go to a Ford or GM dealer next time?

Dealers of Japanese vehicles did not employ a significantly higher percentage of female salespeople than domestic dealers did. In 2000 about 9 percent of the salespeople at Japanese dealers were female—the same percentage as at GM dealers, and only slightly higher than the 6 percent at Ford and 7 percent at DaimlerChrysler. One-fifth of sales personnel at Saturn dealers were female, a reflection and possibly a cause of that model's popularity among women, who made up two-thirds of its customers. The

brand's no-haggling, fixed-price policy was especially comfortable for women visiting the showroom.

Women were responsible for bringing most vehicles to a shop for service and repair. Again, the service experience for women was more pleasant—rather, less unpleasant—at dealers of Japanese brands. Women were more likely than men to demand easy-to-read repair orders, clean waiting rooms, and timely delivery of properly repaired vehicles, and dealers of Japanese vehicles did better at meeting those demands.

The two car makers most responsible for the gender gap during the 1980s and 1990s were Toyota and Ford. Toyota maintained a much higher percentage of female buyers than the other companies, and Ford, a much lower percentage. About 60 percent of Toyota buyers were women, compared to about 40 percent of Ford buyers. The other leading car makers in the United States in 2000—DCX, GM, and Honda—had gender ratios close to the overall fifty-fifty national average.

Toyota's strong showing among women stemmed from the company's high quality ratings. As noted above, women were more concerned than men with reliability, so they gravitated to the company with the strongest reputation for building the most reliable vehicles. Ford's difficulties in selling cars to women were attributed to the company's longstanding advertising strategy of emphasizing products—notably pickup trucks—that appealed primarily to men.

To sell more vehicles in the United States in 2000, Toyota and Ford dealers faced distinctive challenges. Toyota tried to offer vehicles with more appeal to men, notably pickup trucks, without alienating its core female buyers of "sensible" cars. Ford was trying to sell cars with more appeal for women without alienating its core male buyers of "macho" trucks.

Serving the Needs of Ethnic Groups

Owning a car was an especially important symbol of achievement in the 1920s, 1930s, and 1940s for African Americans who had migrated to the big cities of the North and Midwest, especially when they drove back to visit friends and family still living in the rural South (Fig. 10.4). More important, cars allowed African Americans to travel without the problems of discrimination they experienced on trains and buses.

Ethnic minorities, who made up about one in five new vehicle buyers in 2000, were more likely than whites to buy foreign nameplates. DCX, Ford, and GM accounted for about 70 percent of all U.S. car and light truck sales

in 2000, but only about 50 percent among African Americans and 65 percent among Hispanics.[18]

Distinctive preferences derived partly from the greater proportion of women buyers among African Americans than among whites (as discussed above, women tended to favor foreign cars). But even keeping gender constant, African Americans were still more likely than whites to buy foreign cars. African Americans were more likely than other Americans to buy only three of the fourteen nameplates offered by the domestic companies in 2000: GM's Cadillac and Saturn, and Ford's Lincoln. The popularity of Saturn may be attributed to its being marketed to "import intenders" as an alternative to Japanese cars.

Cadillac was long an attractive nameplate to the handful of wealthy African Americans. Prevented from buying homes in white neighborhoods, vacationing at elegant resorts, or shopping in fancy stores, wealthy African Americans spent their money on one of the few symbols of luxury available to them, a Cadillac. But GM prohibited its Cadillac dealers from selling directly to African Americans, fearing that their presence in the showrooms would scare away whites. Wealthy African Americans who wanted a Cadillac had to pay whites to act as "fronts" for them at the dealers.[19]

During the Great Depression, when few people of any color could afford to buy luxury cars, Cadillac sales plummeted, from 18,189 in 1928 to 3,903 in 1933. GM officials seriously considered terminating the Cadillac nameplate, but the division's president Nick Dreystadt pleaded for time to turn the situation around. He was successful: Cadillac sales rose to 11,766 in 1936, 21,965 in 1940, and 60,242 in 1941. Dreystadt was successful primarily because he let dealers sell to African Americans.

Preference for foreign vehicles may not match the economic self-interest of African Americans. Domestic manufacturers were long an important source of employment for African Americans; minorities held 25 percent of the jobs at GM and Chrysler, and 35 percent of the jobs at Ford in 1990.[20] The automotive industry was a traditional route to success for African Americans, who migrated from Mississippi, Alabama, and other Gulf Coast states to Detroit during the 1910s to join the rapidly growing work force in the auto plants. In those plants, however, African Americans were given the least skilled jobs. African Americans held only 1 percent of the skilled jobs at Chrysler, Ford, and GM during the 1940s, 5 percent during the 1960s, and 10 percent during the 1990s. African Americans held about about 25 percent of the unskilled jobs in the domestic auto industry during

10.4. African American couple, late 1940s. Ownership of a car was especially important to African Americans at a time when trains, buses, hotels, restaurants, and shops were segregated in much of the United States. (National Automotive History Collection, Detroit Public Library.)

the 1960s and 40 percent during the 1990s. Plant closures and automation reduced the number of auto industry jobs for African Americans in the Detroit area.[21]

The Ford Motor Company and Henry Ford played an especially prominent role in the life of African Americans. The Rouge had 15,000 African Americans among its 85,000 workers in 1941, and Ford made generous donations to African American churches for construction of housing and provision of social services in Inkster, where many of the company's African American workers resided in the era of residential segregation. For many African Americans during the 1920s and 1930s Henry Ford seemed a godlike figure. Yet Ford put most of the African Americans to work in the dirtiest and hardest jobs, primarily in the foundry. And Ford's Americanization program for immigrant workers in the 1910s included racist com-

ments about African Americans in the program guide: "[African Americans] came from Africa where they lived like other animals in the jungle. White men brought them to America and made them civilized."[22]

The mix of midwestern farmers, African Americans, and southern and eastern European immigrants brought to Detroit to meet the auto industry's labor needs produced racial tensions. The Ku Klux Klan had 200,000 members in Michigan during the 1930s,[23] and Detroit had race riots in 1943. When Chrysler bought the Briggs body plant in 1953, one-fifth of the workers at the plant were African American, but the nearby bars and restaurants on Mack Avenue served whites only. Ford's home city of Dearborn aggressively kept its neighborhoods and commercial facilities segregated into the 1960s. Individual work sites were also segregated. In the 1960s only 20 of the 2,400 workers at GM's Fisher Body Livonia plant were African American, and only 6 of 4,000 at GM's Technical Center in Warren, compared to more than half of the 7,000 employees at Chrysler's Dodge Main plant in Hamtramck.

Japanese firms deliberately located their U.S. plants away from concentrations of African Americans. The proportion of African Americans was around 2 percent in Lafayette, Indiana, near the Subaru/Isuzu assembly plant; 4 percent around Mitsubishi's Normal, Illinois, plant; 10 percent around Nissan's Smyrna, Tennessee, plant; and 11 percent near Honda's plants in Marysville and East Liberty, Ohio. In 1990 African Americans made up about 11 percent of the work force at Honda, 14 percent at Toyota, 18 percent at Nissan, and 19 percent at Mazda.[24] Companies owned by African Americans sold domestic manufacturers about 5 percent of their supplies, compared to less than 1 percent of foreign manufacturers' supplies. About 4 percent of dealers of both domestic and foreign vehicles were minority-owned.

The U.S. Equal Employment Opportunity Commission (EEOC) alleged that Honda effectively screened out African Americans from working at its Marysville plant by requiring that applicants live within 20 miles of the plant, while most of the region's African Americans lived about 30 miles away, in the city of Columbus. Honda settled with the EEOC in 1988, agreeing to pay $6 million in back pay to 370 African American and female employees who should have been hired sooner, according to the government. Honda also agreed to expand its recruitment to a 30-mile radius, thereby encompassing African American neighborhoods in Columbus. Honda's African American work force increased during the 1990s from 5 percent to 11 percent.[25]

Japanese companies claimed that the plant sites were selected for reasons other than the community's racial composition. They cited low-cost land, access to good transportation, and high educational levels. However, they also talked about the importance of a "work ethic": especially notorious was a 1986 statement by then Japanese prime minister Yashuhiro Nakasone that Japan's racial homogeneity made it a more "intelligent society [than the United States] where there are blacks, Mexicans and Puerto Ricans."[26]

Ethnic differences in buying preferences appeared only in the 1990s, long after Japanese vehicles had become popular in the United States. For example, the Big Three combined held three-fourths of the market among both African Americans and whites in 1980. GM accounted for 49 percent of the vehicles purchased by African Americans and 45 percent of those bought by all Americans that year; Ford, 20 percent for both groups; and Chrysler, 5 percent for African Americans and 9 percent for all Americans.[27]

Because African Americans' preference for foreign cars emerged only in the 1980s, the explanation was less likely to be rooted in history than in marketing efforts. Until the 1990s foreign car makers refused to buy air time on radio stations with primarily African American audiences. In the 1990s Japanese firms decided to reach African Americans by running advertisements in black-oriented media that showed vehicles without people or replaced white actors with African Americans speaking the same lines. African American–owned agencies created advertisements depicting African Americans in positive family situations, to counter negative images in newscasts and popular culture. Japanese manufacturers also fostered positive images in the African American community by making financial contributions to such organizations as the NAACP.

Serving the Needs of Different Age Groups

The motor vehicle was invented long before the baby boom—the period between 1945 and 1964 when more than 80 million Americans were born. But boomers have had a more profound impact on the auto industry than any other age group at any time and any place.

As children in the 1950s, boomers were the first generation to be hauled everywhere in a car by mothers who had no choice but to drive, since the families had moved to sprawling suburbs that lacked any other mode of transport. As a result, car ownership became nearly universal in the United States, and half the households had more than one car.

As young adults in the 1970s, boomers were the first generation to buy foreign cars, because they wanted higher gas mileage, more reliability—or simply something different than their parents' and grandparents' Detroit "dinosaurs." As a result of boomers' preferences, the U.S. auto industry was transformed into a global one.

As middle-aged adults in the 1990s, boomers were the first generation to obsess over personal safety, because they wanted to protect their children—or themselves—from perceived dangers of the highway. As a result of boomers' fears, half of American motorists drove tanklike trucks and the other half drove padded cocoons.

As retirees in the 2010s, boomers will be the first generation to have yet another major impact on the motor vehicle industry—still in the future when this book was written. As a result of boomers' aging, motor vehicles will somehow cushion the ravages of old age.

During the 1950s, when the parents of boomers bought their first cars, essentially their choice was restricted to Big Three products. They were the last of several generations of consumers who bought within the framework of GM's income-based brand segmentation. Most bought Fords and Chevrolets, although some "progressed" to more expensive and luxurious Oldsmobiles and Buicks.

During the 1970s, boomers themselves started buying cars in large numbers in the midst of economic turmoil precipitated by the energy crisis. The buying habits of boomers partly responded to these upheavals and partly created them. Boomers were looking for alternatives to their parents' lifestyles, and buying small, energy-efficient, foreign cars fit the bill. Boomers gave Japanese products their first entry into the U.S. market as a statement that they themselves were conserving fuel, while their parents drove large American-built cars that got 15 miles per gallon. Two decades later few boomers seemed to see the irony when they bought trucks that got lower gas mileage than their parents' old "dinosaurs."

During the 1990s boomers constituted a very high percentage of new vehicle buyers: not only were boomers numerous, but also they had entered the prime age for new vehicle buying. With the aging of the boomers, the median age of buyers of new vehicles increased rapidly during the 1990s, from about forty to fifty.

As the age of average buyers increased, so did the average cost of new vehicles during the 1990s. The number of weeks of wages that the average American household needed to earn to pay for a new vehicle had decreased from thirty weeks in 1950 to eighteen weeks in 1980, but then increased to

twenty-two weeks in 1990 and 2000. Median household income, which was $6,000 in 1960, rose rapidly in the late twentieth century from $20,000 in 1980 to $50,000 in 2000. But the average price of a new vehicle, which was $3,000 in 1960, rose faster, to $7,000 in 1980 and $22,000 in 2000. Vehicle prices increased relatively rapidly primarily because boomers demanded more features. So cause and effect were not clear: did boomers increasingly dominate the market because younger people couldn't afford new cars, while boomers could? Or did vehicle prices increase beyond the means of young people because boomers were willing to pay for more features?

The most expensive features that boomers demanded in the 1990s were safety-related. For most of the twentieth century, one of the "ironclad" rules in the automotive industry was "safety doesn't sell." Through the first century of motoring, consumers had a skittish view of safety improvements. They appreciated safety improvements that also improved operations, such as the self-starter and brakes on all four wheels. But consumers showed reluctance to pay for safety improvements when made available as options, and they did not wish to be reminded of the dangers associated with driving their expensive new purchase.

A clear test of consumer resistance to paying for safety improvements came in 1956, when Ford decided to emphasize in its advertising the availability of a safety package called "Lifeguard Design." With research showing that many accidents resulted in drivers being impaled on steering columns, Ford designed the steering wheel in a deep-dish shape to cushion drivers thrown forward in accidents. With research indicating that in one-fourth of accidents motorists were thrown out of the car, Ford designed latches that kept doors closed during most accidents. Seat belts were a $16 option, $25 if bought in a package along with padded instrument panel and sun visors.[28]

Ford, along with Chrysler, had made seat belts an option in 1955, and sold 400,000 in the first eighteen months of availability. Company vice president Robert McNamara said that no other optional accessory had "ever caught on so fast."[29] But the novelty wore off quickly. Ford trailed Chevrolet in sales by 67,000 in 1955, and outsold Chevrolet by 37,000 in 1957. But in 1956, the year of the safety campaign, Chevrolet outsold Ford by 190,000.

To pay for the safety improvements in 1956, Ford made only minor cosmetic changes to its 1955 models. GM also made only cosmetic exterior changes to Chevrolet in 1956, but instead of safety features it spent money

on more powerful engine options and advertised Chevrolet with the boast that "the hot one's even hotter." Ford salvaged its 1956 sales by dropping the "Lifeguard Design" advertisement campaign midway through the year. But Ford's grim experience that year discouraged all car makers (except Volvo) for nearly a half-century from emphasizing safety in their advertisements.

Safety suddenly sold again in the 1990s. Aging baby boomers—more obsessed with protecting their children than their parents had been with protecting them—suddenly sought out passive restraints, antilock brakes, improved crash protection, high-mounted rear brake lights, and any other safety-related feature that the car makers could invent. Use of seat belts increased from 12 percent of the population in 1986 to 68 percent in 1998. National campaigns reduced the number of accidents caused by drunk drivers.

As a result of safer vehicles and more careful drivers, the number of accident-related fatalities—which had increased through the twentieth century to a peak of 55,000 in 1970—decreased to 53,000 in 1980, 47,000 in 1990, and 40,000 in 2000. Given the large increase in the amount of driving, the number of fatalities per 100 million miles driven in the United States declined 95 percent, from 18 in 1920 to 5 in 1960, 3 in 1980, and 1 in 2000.

Evidence of boomers' obsession with safety during the 1990s was the airbag saga. Air bags installed in the steering wheel and instrument panel to protect front-seat drivers were available back in the 1960s, but consumers were not interested in buying them then. Air bags were suddenly in great demand in the 1990s, so manufacturers quickly installed them. However, first-generation air bags deployed very powerfully, killing about two dozen children and very short adults sitting in the front seat, and injuring many more.

Following emotional testimony from parents of children killed by deploying air bags, the National Highway Transportation Safety Administration (NHTSA) issued rules in 1998 allowing qualified motorists to have a switch installed to turn off the air bag. Switches would be authorized for people with certain medical conditions, those who could not sit at least 10 inches from the steering wheel, and those having to transport small children in the front seat. Within six months the NHTSA approved requests for switches from 30,594 motorists, but only 1,065 forms were returned from dealers showing that the switch had actually been installed. Meanwhile, second-generation, "smart" air bags were quickly developed and installed in new vehicles.

As boomers dominated the U.S. market during the 1990s, to some extent they emulated their parents' earlier behavior. Where their parents had

stepped up GM's "ladder of success" from Chevrolet and Pontiac through Oldsmobile and Buick to Cadillac, boomers could step up through similar ladders of success created by Japanese companies. They traded in their Honda Civic for an Accord or an Acura, and their Toyota Corolla for a Camry or a Lexus. Having had positive experiences with smaller Japanese cars beginning in the 1970s, boomers saw no reason to switch to competing U.S.–made cars that were nearly as good as the Japanese models.

Buyers of domestic vehicles in the late twentieth century were about ten years older than import buyers, in their fifties compared to the forties. This age gap reflected the major break between buyers born before and after World War II, between boomers and their parents. The age gap created panic among the Big Three during the 1990s. The average age was well over sixty for the buyers of many domestic models, including Buick, Cadillac, and Lincoln. With gallows humor, domestic car makers joked that the next vehicle for these buyers would be a hearse.

Boomers will continue to influence vehicle-buying habits in the twenty-first century, long after they themselves stop buying. Boomers gave birth to a large number of children who began to drive and then to buy vehicles in the late twentieth century. Marketing analysts called the children of boomers the Net Generation, because they were the first cohort to grow up using the Internet. The Net Generation was also known as Generation Y, because Generation X was the term applied those younger than boomers but older than boomers' children, born between 1965 and 1979. Generation Xers were fewer in number and defined largely as "not boomers" rather than as holding distinctive values in their own right.

When they began to buy new vehicles in large numbers around 2000, the Net Generation certainly did not wish to emulate their parents' choices. Their parents' favorite Toyota was too boring and stodgy, and their grandparents' favorite Buick was too expensive and stodgy. Having largely written off the boomers as a lost generation, domestic manufacturers looked to the Net Generation to reclaim market share—largely with trucks, especially pickups and small SUVs. But what the Net Generation really liked for their first vehicle was an affordable European brand with distinctive styling—that is, a Volkswagen—ironically, the first car owned by many of their boomer parents when they were flower children back in the 1960s.

11 *From a National Market . . .*

"We'd rather do without clothes than give up the car."
"I'll go without food before I'll see us give up the car."
—Citizens of Middletown, interviewed by Robert and Helen Lynd, 1920s

Robert and Helen Lynd observed during the 1920s that the motor vehicle had become an accepted essential of normal living in the United States. It served as the primary focal point of urban family life and made leisure activity a customary aspect of everyday experience. Business people considered ownership of a luxury vehicle as a symbol of wealth, while working-class people saw ownership of any vehicle as a great symbol of advancement.

When the Lynds wrote *Middletown,* the United States was nearing an important milestone: there were almost as many motor vehicles as households. Universal access to motor vehicles had become one of the most important elements defining the American nationality. With a level of dependency on motor vehicles far higher than that of any other country, the United States developed a distinctive landscape of cities and countryside that looked like nowhere else on Earth. The world had about 20 million motor vehicles during the 1920s, and Americans owned about 17 million of them. American companies produced most of the world's motor vehicles, and they did so in American assembly plants, using American-made parts, put together by American workers.

The United States lost its global dominance in motor vehicle ownership, production, and sales during the second half of the twentieth century. As recently as 1950 the United States possessed 60 percent of the world's 80 million motor vehicles and accounted for 80 percent of the world's production of 10 million vehicles. In 2000 the United States possessed only 30 percent of the world's 700 million vehicles and accounted for only 20 percent of the world's production of 56 million vehicles. Japan

and many European countries had a rate of motor vehicle ownership comparable to that of the United States. Still, the United States achieved another milestone during the 1990s when it became the only major country to have more motor vehicles than licensed drivers.

The United States as the First "Car Culture"

Three elements defined the distinctive national market for motor vehicles in the United States during the twentieth century: practicality, convenience, and status. The motor vehicle proved to be more practical than other forms of transport for moving people and goods in America's rural and urban areas. Motor vehicle travel became more convenient because roads were built to accommodate motor vehicles, while other forms of transport were allowed to wither. And owning and operating a motor vehicle became a matter of high social status in American culture.

Practicality

In 1900 the streets of U.S. cities were congested with horses and horse-drawn vehicles, and teeming throngs of humanity jostled on sidewalks. Surrounding rural areas were sprinkled with isolated farms, cut off from the economic and cultural opportunities of the cities. Rapid diffusion of motor vehicle ownership during the first half of the twentieth century alleviated congestion in U.S. cities and ended rural isolation.

In 1900 a motor vehicle, compared to a horse, was regarded with disdain by many rural residents. A motor vehicle was noisy, dirty, unreliable, and expensive to operate, a toy for the idle rich, whereas a horse was a member of the family. Rural residents became convinced of the need to buy a motor vehicle when they came to see it as a means of reaching town to deliver their produce, buy needed supplies, and find entertainment. During hard times the motor vehicle enabled farmers to migrate to the cities, and during desperate times to migrate from the Dust Bowl to California.

In the late nineteenth century the railroad made possible rapid movement between major cities, but few rural residents benefited because trains stopped infrequently. The handful of small-town stations where the trains did stop were like pearls strung along the railroad line. Around the stations economic and social activity bustled. It cost a farmer as much to carry wheat 10 miles from the farm to the small-town station by horse-drawn wagon as it did for the railroad to ship it more than 1,000 miles to New York. High shipping costs made growing wheat more than 20 miles

from a station uneconomical. Dairy products and other perishables had to be grown within 10 miles of a station. So beyond a 10–12-mile radius of a station, rural farms remained isolated.

Hauling crops by truck allowed farmers to more than double their shipping distances and halve their shipping costs per ton mile, according to a 1920 survey by the U.S. Department of Agriculture. Only 7 percent of U.S. farmers owned trucks during the 1920s, but 40 percent were able to have crops hauled to market by trucks owned either by neighbors or common carriers.[1]

The motor vehicle transformed decaying farm towns into bustling market centers. Small towns with between 1,000 and 5,000 inhabitants contained 9 percent of the U.S. population in 1920, but 20 percent of the motor vehicles. The consolidation of one-room schoolhouses into modern school buildings, begun in the nineteenth century, progressed rapidly with the introduction of buses. In 1926, 30,000 of the country's 80,000 buses were used to bring 500,000 children to schools consolidated in rural market centers. Motor vehicles helped small-town doctors visit more patients and get their rural patients better care at small-town hospitals.

Small towns also gained urban visitors on holiday. People drove their cars to visit previously inaccessible national parks, camp deep in the wilderness, eat in roadside restaurants, and sleep in motor hotels (soon shortened to *motels*). Along the way, they could read signs erected at the side of the road by BurmaShave and other advertisers.

Within cities, most people traveled by foot before the motor vehicle age. Pedestrians were rarely able to walk more than 1 mile per hour because sidewalks were overcrowded with too many people trying to move in all directions. "On a busy Summer day [in 1900 in New York] it is almost impossible to cross some of the main thoroughfares. An eminent local philosopher said, years ago, that it required more talent to cross Broadway, below the Astor House, than it did to be a Representative to Congress."[2] The alternative to walking was using a horse. The U.S. horse population in 1900 was 30 million in a country of 15 million households. A century later the United States had 200 million motor vehicles and 100 million households—the same two-to-one ratio between households and transport.

Rapidly growing nineteenth-century cities tried to reduce congestion through the development of public transit systems. Typically, a private company received from a city government an exclusive franchise to offer public transit service, in exchange for agreeing to maintain certain standards. The principal form of public transit during the first half of the nine-

teenth century was the horse-drawn omnibus. The driver sat in the front, while passengers dropped the fare in a slot and sat in a cushioned compartment with glass windows. Omnibus passengers bounced along deeply rutted, cobblestone streets, perched on unpadded seats in a poorly ventilated compartment. Public transit saved the pedestrian energy but little time, because speeds were restricted to less than 5 miles per hour by competition for the limited amount of space in the streets.[3]

The horse-drawn streetcar, which became widespread during the 1850s, overcame some of the limitations of the earlier public transit systems. With rails reducing friction, a horse could pull more passengers in much more comfort in a streetcar than had been possible in an omnibus. Cable cars were installed in some cities—most famously, San Francisco in 1873—to get people up and down steep hills.[4] An electric streetcar, which received power from overhead wires, was first used successfully in 1888 in Richmond, Virginia. Traveling at 10 mph, the electric streetcar made it possible for middle-income people to buy houses along a radial line in a so-called "streetcar suburb," such as the Boston suburbs of Roxbury, West Roxbury, and Dorchester.[5] As streetcar lines were extended, farmland at the edge of cities became valuable sites for new homes.

Elevated railroad lines were built beginning in the 1870s, but the expense of building the noisy, dirty overhead rail lines could be justified only in the largest and most congested cities, such as New York and Chicago. Because they needed a long time to get up a head of steam, elevated trains stopped infrequently and therefore made a limited contribution to urban life until they were converted to electric power in the late nineteenth century. The country's first subway line opened in Boston in 1897, and New York City's first, in 1904. Electric subway and elevated rapid transit routes followed the most traveled routes of horse-drawn omnibus and electric streetcar systems. Because of much greater fixed costs, rapid transit lines were built much more slowly and in fewer places than streetcar lines. Trains could travel longer distances more rapidly, but stations were farther apart than streetcar stops.

By the mid-twentieth century U.S. cities had 30,000 miles of streetcars that carried 14 billion passengers a year, but fifty years later only a few hundred miles of track remained. Los Angeles—the city perhaps most associated with the motor vehicle—had a streetcar network exceeding 1,000 miles in the late 1940s, but the lines were abandoned as freeways were built. Ridership by streetcar and subway declined in the United States from 12 billion in 1950 to 3 billion in 2000.

General Motors acquired many of the privately owned streetcar companies and replaced the trolleys with buses that the company made. Buses offered a more flexible service than trolleys, because they were not restricted to fixed tracks. However, bus ridership declined from 11 billion riders in 1950 to 5 billion in 2000. In many cities buses acquired a stigma that only poor people used them. As a bus driver in a major midwestern city put it, around 1980, "Ain't nobody rides the bus except old folks and po' folks." Or, according to a sign seen posted beside the door of a bus, "Losers enter here."

Despite improvements in public transit, the private car quickly became the most important form of transport in U.S. cities. In 1930 the United States had 982 cities with at least 10,000 inhabitants, and 222 of them did not have any public transit—thus, those cities were already entirely dependent on motor vehicles.[6] Even in cities with extensive public transit systems, the car was used for most purposes by 1930, including commuting to work downtown. The U.S. Bureau of the Census in 1930 found that one-fourth of all commuters into the downtowns of U.S. cities—including those cities with public transit systems—were driving private cars, and even in large cities more than one-half were commuting by car.

Economic hardship during the 1930s and rationing of petroleum during World War II temporarily slowed the growth in commuting by private car. But the surge resumed after World War II. In 1960 two-thirds of commuters in U.S. cities reached work by private car, only one-sixth still relied on public transit, and the remaining one-sixth walked or biked. Even in the New York metropolitan area, people used private cars more often than public transit to get to work in 1960.

As more cars were placed on the streets of U.S. cities, people moved faster. Average traffic speed during rush hour increased from less than 5 mph in 1900 to 20 mph in the 1950s and 30 mph in the 1960s. Even in densely congested Manhattan, rush-hour speeds increased during the first half of the twentieth century from less than 2 mph to 10 mph. Outside rush hour, speeds increased much more dramatically.[7]

Convenience

To take full advantage of the practical benefits of motor vehicles, motorists needed paved roads. In the words of an early auto industry chronicler, "it is sometimes said that the automobile has caused good roads; sometimes, that the construction of good roads has caused the great development of the automobile industry. Both statements are true; here, as so often in economic matters, cause and effect have constantly interacted."[8]

In urban areas the condition of the streets made use of motor vehicles difficult in 1900 (Fig. 11.1). Streets were paved with such materials as wood blocks, stone blocks, gravel, and cobblestones. One-third of all streets in Washington, D.C., were unpaved in 1890, two-fifths of the streets in New Orleans and Pittsburgh, and four-fifths of the streets in Kansas City. Even Manhattan had many dirt roads in the late nineteenth century. Smaller towns contented themselves with dirt or gravel streets.[9] Brick was widely used in the mid-1880s, especially in midwestern cities. Discovery of natural beds of pitch on Trinidad brought attention to asphalt, a paving substance already widely used in London and Paris.

Rural roads were in even worse condition in 1900. When the Office of Public Roads Inquiry undertook the first inventory of all U.S. roads in

11.1. Oldsmobile Curved Dash stuck in mud, c. 1902. Unpaved roads limited use of cars in the United States in the early twentieth century. (National Automotive History Collection, Detroit Public Library)

1904, the country had 2,151,570 miles of rural public roads, but only 153,662 miles with any kind of surfacing. States had chartered private companies to operate roads and to charge tolls for construction and maintenance. These roads were called "turnpikes," because poles armed with pikes hung across the road where tolls were collected, and the poles were turned to let travelers pass after paying. The first turnpike, between Philadelphia and Lancaster, Pennsylvania, was chartered in 1790, begun in 1792, and completed in 1794.

Some turnpikes were built with state and federal government aid. Most prominent was the Cumberland Road or National Pike, begun in 1806 from Cumberland, Maryland, and eventually reaching Vandalia, Illinois, in 1827. The National Pike was an engineering marvel—80 feet wide, with bridges across streams—but its most distinctive feature was a center track, 30–40 feet wide, made not of dirt but of the new macadam technology, a 10-inch layer of compacted small stones. Macadam was sufficiently durable for rural roads, if not for those in the center of cities.[10]

With the rapid growth in ownership of inexpensive Model T Fords stimulating demand, the federal government enacted the Federal Aid Road Act in 1916 to hasten the pace of rural road construction. The act appropriated $75 million a year to pay half the cost of building rural post roads, up to $10,000 per mile (later raised to $20,000 per mile). States had to agree to pay the remaining half of the cost, maintain the roads, and keep them free of tolls. The amount of surfaced roads in the United States increased from 257,291 miles in 1914 to 521,915 miles in 1926. When the system was completed during the 1930s, 90 percent of the U.S. population lived within 10 miles of a Federal Aid road.[11]

The Federal Highway Act of 1921 called for designation of a national highway system of interconnected roads. No more than 7 percent of a state's public roads could be included in the system. The complete national system of 96,626 miles was approved in 1926 and identified by the U.S. highway numbers still in use. The old National Pike was incorporated into U.S. 40, which ran between Atlantic City, New Jersey, and San Francisco, California.

Limited-access parkways modeled on the German *autobahn* highways were planned during the 1930s, and the first (the Pennsylvania Turnpike) opened in 1940. Robert Moses, New York's long-time parks commissioner, constructed parkways from New York City to the beaches of Long Island and the forests of Westchester County. Moses envisioned the New York parkways being used only for recreational driving, so commercial vehicles

were banned, and to ensure that the ban would always remain in effect, Moses had the bridges crossing the parkways built with clearances too low for trucks. During the national boom in truck ownership around 2000, New Yorkers hesitated to buy pickups because commercial vehicles were still banned from many of the region's parkways.

The Interstate Defense Highway Act of 1956 called for construction of 44,000 miles of limited-access highways across the United States. To gain passage of the bill, the Eisenhower administration tied the highways to defense, emphasizing the need to move large numbers of soldiers and equipment across the country in a short period of time, as well as to ensure rapid escape from a city under attack. The federal government paid for 90 percent of the cost to construct the interstates. Most of the miles of interstate highways were constructed to connect cities, but most of the dollars were spent to cross inside cities.

The trucking industry especially benefited from the interstate highways. Rail and truck shared about evenly in the growth of freight handling during the first half of the twentieth century—railroads increasing from 896 million tons in 1906 to 1.4 billion tons in 1950, and trucks from nil in 1906 to 800 million tons in 1950. But over the next two decades, after completion of most rural interstate highways, truck haulage more than doubled, to 1.9 billion tons, while railroads carried 1.5 billion tons, about the same as in 1950. Railroads were relegated to longer distance hauling.

With construction of the interstate highways, the United States became a nation of suburbanites. The number of Americans living in suburbs increased from 30 million in 1950 to 120 million in 1990, while the number in cities of at least 50,000 inhabitants declined from 60 million to 40 million, and the number in rural areas declined from 60 million to 50 million. In 1950, 40 percent of Americans lived in rural areas, 40 percent in cities, and 20 percent in suburbs. A half-century later, after construction of the interstate highways, 20 percent of Americans lived in rural areas, 20 percent in cities, and 60 percent in suburbs.

People drove farther because they needed to do so to reach jobs, shops, and recreation. Taking advantage of increased speeds afforded by cars, people chose to make longer trips rather than to reduce travel time. The average motorist drove 25 percent more per year in 2000 than in 1950. Average commuting distance increased 15 percent just between 1950 and 1960, offsetting a 15 percent increase in average speed that decade. Ownership of private cars enabled Americans to move to suburban houses and travel to shops, jobs, and entertainment downtown. Soon, the shops, jobs,

and entertainment also moved to sprawling, spread-out suburbs, further adding to people's travel time.

Status

A researcher for the U.S. Department of Agriculture in the 1920s asked a farm wife why her family had bought a car before installing indoor plumbing. Her response: "Why, you can't go to town in a bathtub!"[12] The motor vehicle eliminated rural and small-town isolation in America during the first half of the twentieth century, first economically and then socially.

The farmer's feeling of isolation was deepened by a knowledge of jobs, shops, and amusements clustered in the rapidly growing cities, not many miles away. Rural "pastimes and diversions paled before the bright attractions of the city." For younger people, the "occasional pleasures" of country life did not make up for "the drudgery and monotony which attended much of the daily toil."[13]

Social analysts in the United States during the 1920s and 1930s observed the creation of an "automobile psychology," as it was called by the President's Research Committee on Social Trends. The committee noted that "the automobile has become a dominant influence in the life of the individual and he, in a very real sense, has become dependent on it."[14]

The interstate highways constructed during the second half of the twentieth century enabled more Americans to drive many more vehicles many more miles on a few more roads—and suburbanization required them to do so. In 1950, before construction of the interstate highways, 150 million Americans drove 48 million vehicles a total of 458 billion miles on 2 million miles of paved roads. A half-century later, 275 million Americans drove 220 million vehicles a total of 2.5 trillion miles on 4 million miles of paved roads. Thus in the second half of the twentieth century the number of Americans nearly doubled, the number of roads doubled, the number of vehicles more than quadrupled, and the number of miles driven more than quintupled.

By 2000, faced with the difficulty of increasing capacity through new road construction, engineers tried to ease congestion by making more efficient use of existing highways. They used such devices as designated carpool lanes, construction of park-and-ride lots, and promotion of staggered work hours. Technological improvements further helped traffic flow. A navigation system used in some vehicles, receiving continuously updated traffic data from satellites, alerted the driver to traffic jams and suggested alternate routes.[15] Several heavily used freeways were reconstructed during

the 1990s so that someday they could accommodate more vehicles through sensors in the pavement that controlled speed and distances between vehicles by regulating acceleration, braking, and steering. Smaller cars took up less space on the freeways.[16]

If not by increasing supply, congestion could be eased only by reducing demand. Public transit lines were constructed to entice motorists, and they were often sited parallel to congested freeways. New trolley lines—known by the more elegant term of *fixed light rail transit*—were built in ten North American cities during the late twentieth century, although new construction in all ten cities amounted to only about 130 miles. Subway lines were added or extended in some U.S. cities, including Atlanta, San Francisco, and Washington, D.C., but construction was very expensive and the lines served only a tiny percentage of travelers. Demand was also reduced by charging motorists for the use of existing roads and building new toll roads.

Despite the wide variety of available technological strategies, congestion persisted primarily because most Americans did not behave the way traffic engineers and economists thought they "should." Back in the 1950s planners conducted elaborate studies to determine the optimal locations for new highways in response to travel demand patterns. The location of residences, shops, offices, and entertainment centers generated measurable amounts of traffic at specific times of the day. New highways were situated to accommodate existing and projected demand to travel among these activities. Ignored in the planning was the reciprocal relationship between highways and land uses. Highways were located in response to changing land uses, but in reality they also caused changing land uses. A highway built in the middle of nowhere soon sprouted commercial establishments and residential subdivisions near the interchanges. Planners learned that if they built highways, motorists would come.

More important, Americans coped with congestion not by altering their driving patterns but by regarding their motor vehicles as more than a mere means of conveyance. A motor vehicle became an American's most important expression of personal space. Driving alone on a congested freeway, an American could eat; change clothes; enjoy entertainment in the form of radio, cassettes, or compact discs; communicate; and work in the vehicle.

Americans have long consumed food while sitting in their vehicles. Drive-in restaurants became popular destinations in the 1950s(Fig. 11.2). Rather than go into a restaurant, patrons sat in their vehicles while a waitress took the order, attached a tray to the door, and brought the food,

11.2. McDonald's, 1950s. Drive-in restaurants became popular in the 1950s. (McDonald's Corp.)

sometimes doing so on roller skates. Drive-in restaurants were more popular than ever in 2000, but as a stop to secure food while on the way to somewhere else, rather than as a destination. The restaurants wrapped the food so it could be eaten while people were driving, and vehicles were equipped with holders for beverages.

Motor vehicles became closets, holding changes of shoes, gym clothes, after-work casual wear, outerwear, and rain gear. Women applied their makeup on the way to work. Modesty seemed to preclude only showering and changing underwear in a vehicle.

Americans had long enjoyed entertainment while driving. Radios became popular vehicle accessories within a decade of the start of commercial broadcasts in the 1920s. Motorists removed factory-installed AM radios during the 1980s and replaced them with aftermarket kits tailored to their preferences. Vehicle producers responded by offering an array of factory-installed entertainment choices: FM receivers, tape decks, CD players, even Internet access. Motorists could choose from a wide variety of radio stations, pop in their own tunes, listen to a book, or surf the Web.

Motor vehicles became communications centers as well. Citizen's band radios, favored by truckers, enjoyed a brief popularity among other motorists to call for emergency help and to participate in group conversations

with others nearby who were tuned to the same frequency at the same time. Cellular telephones were sold to many drivers in the 1990s as an emergency resource, as well as a means for conducting business while away from the office. Car phones quickly supplemented home-based telephones for personal conversations.

Traveling salespeople and service people making house calls had long used their vehicles as extensions of offices. As an office, a motor vehicle historically did little more than hold papers and samples, while the driver remained out of touch with colleagues and clients when on the road. In 2000 drivers could write memos, complete spreadsheets, and send and receive voice or electronic messages. Sitting in a traffic jam became an opportunity to conduct business, not to lose it. According to one prediction, "by the end of the 21st Century . . . several generations of drivers will perceive the automobile not as a mechanical device that transports them to and from work. Rather, they will see the automobile as a bundle of complicated electronic, cellular and satellite gadgetry that keeps them—for better or worse—in communication with bosses, friends and even government authorities."[17] No wonder Americans are notorious for never using their turn signals and disliking manual gearshifts: their hands are too busy doing other things having nothing to do with the operation of the vehicle.

Blurring National Identity in the United States

Americans displayed many overt symbols of nationality in 2000, from playing the national anthem before concerts and sporting events to displaying the flag in theaters and ballparks. Americans heard relatively little about other nationalities on the nightly news, and were leery of economic or military entanglements with other nations. A notable exception to nationalistic behavior in 2000 was buying cars—Americans did not particularly care about the nationality of their vehicles.

In the 1950s GM advertisements portrayed buying a Chevrolet as a patriotic act, when Dinah Shore and Pat Boone sang:

> See the U.S.A. in your Chevrolet, America is asking you to call.
> Drive your Chevrolet through the U.S.A., America's the greatest land of all.

A generation later nearly one-half of vehicles sold in the United States were made by foreign-owned companies.

The national origin of cars sold in the United States could be clearly distinguished for most of the twentieth century. Foreign cars looked different

than American-made ones. Virtually all American cars exceeded 200 inches in length and contained engines with displacements of at least 4 liters and having six or eight cylinders. Foreign cars were several feet shorter than American-made models and contained four-cylinder engines with less than 2 liters of displacement. Large American cars were built in the United States by American-owned companies with American-made parts and American workers, and were sold under brand names that the American companies continued to use for a century. Small foreign cars were built in other countries by foreign-owned companies and imported to the United States ready to sell.

By the 1990s the distinction between domestic and foreign motor vehicles in the United States had become blurred. No longer was any vehicle purely American or totally foreign. Newspapers, automotive enthusiast magazines, and consumer-oriented publications delighted in pointing out the confused national origin of many vehicles. Confusing nationality was a deliberate tactic on the part of both producers and buyers.

The U.S. government made several attempts to classify vehicles as domestic and imported, but these efforts added to the confusion. Government agencies did not agree on how to distinguish between domestic and foreign vehicles, and they divided vehicles into two mutually exclusive, "all-or-nothing" categories of "domestic" and "foreign." The three most widely used government measures of domestic content were the Environmental Protection Agency's CAFE standards, the Department of Treasury's Customs Service tariff standards, and the 1992 Labeling Law. Essentially, a vehicle was defined as American if the domestic content exceeded at least 75 percent (CAFE), 62 percent (Customs Service), and 85 percent (Labeling Law); moreover, the three defined "domestic content" differently.

The EPA's approach to measuring domestic content was the standard followed most closely in the industry, because it carried the highest penalties for violation. According to CAFE (see chapter 8), the combined fuel economy (in miles per gallon) of all vehicles that a company both produced and sold in the United States had to exceed the two specified averages, for cars and for trucks. Similarly, the combined fuel economy of all vehicles that a company imported for sale in the United States had to exceed the two specified averages. The EPA considered a vehicle domestic if at least 75 percent of its content came from North America, originally defined as the United States or Canada, and broadened after the 1993 North American Free Trade Agreement (NAFTA) to include Mexico.

CAFE designated each vehicle model as entirely domestic or entirely imported, depending on whether the 75 percent threshold was achieved, regardless of where the vehicle was assembled or the components were made. Motor vehicle manufacturers took advantage of this "all or nothing" provision to increase or lower domestic content in their models to assure that both their domestic and imported fleets exceeded fuel economy standards. For example, Toyota assembled in North America several small, fuel-efficient models that contained at least 75 percent North American content, but the company deliberately brought into the United States enough of those same models built in Japan so that the domestic content levels for the models fell below 75 percent. By having their relatively fuel-efficient models counted as entirely foreign, Toyota could also import to the United States larger, less fuel-efficient models and still have its overall import fleet meet the CAFE standard.

The Ford Motor Company's largest Ford and Mercury models during the 1990s, the Crown Victoria and Grand Marquis, were classified as imports, even though they appealed to older Americans who preferred traditional, full-sized domestic cars. Ford reduced the domestic content of these vehicles below 75 percent so that the company's overall fuel-efficiency rating for domestic cars met the CAFE standard. At the same time, because Ford was also importing small, fuel-efficient models, classifying the Crown Victoria and Grand Marquis as imports did not cause the company's overall import fuel efficiency to exceed the CAFE standard. These types of manipulations lent credence to the widespread consumer perception that there were no clear-cut distinctions between domestic and imported cars.

In its attempt to distinguish between domestic and imported vehicles, the U.S. Department of Treasury's Customs Service set its standard at 50 percent U.S. and Canadian content, under the 1965 Canadian–U.S. Automotive Products Trade Agreement. Cars with less than 50 percent North American content were subject to a 2.5 percent tariff; pickup trucks, a 25 percent tariff. NAFTA stipulated that at least 50 percent of the content of vehicles sold in the United States could be made in Mexico, as well as the United States or Canada; the combined percentage of Mexican, U.S., and Canadian content needed to avoid the 2.5 percent tariff rose to 62 percent five years after enactment of NAFTA.

The American Automobile Labeling Act of 1992 required that every new vehicle sold in the United States after October 1, 1994, display a sticker showing where the vehicle, engine, and transmission (or transaxle) were

assembled. If a vehicle had less than 85 percent U.S. and Canadian content, the sticker needed to show the two foreign countries contributing the most. To facilitate accurate calculations, independent suppliers of components had to certify to vehicle manufacturers the national origin of the parts and materials they used. A part had to have at least 70 percent U.S. and Canadian content to count as domestically made. The 85 percent level was not selected arbitrarily—it was nearly the precise percentage of domestic content in Ford and Chrysler vehicles and well under GM's 95 percent, yet higher than that of any foreign-owned company.[18]

National Origin of Direct Production Costs

Government efforts to classify all vehicles into two groups foundered because no vehicle was 100 percent domestic or 100 percent foreign. National origin was a relative, not an absolute, concept, so the "all or nothing" government approaches further blurred rather than clarified meaningful distinctions. A more constructive approach would have been to place individual models and companies along a continuum from relatively low to relatively high percentages of domestic content.

The domestic content of vehicles sold in the United States could be estimated for an individual vehicle by identifying the national origin of major elements embedded in the vehicle's selling price—the direct production costs attributable to a particular model and the indirect costs of management shared with a company's other models. Major direct production costs included research and development prior to the model's introduction, purchase of thousands of components, assembly of the components into a finished vehicle, and shipping of the vehicle from the final assembly plant to the dealer. Major indirect costs included central administration, corporate profit, advertising, and dealer expenses and profit.

Costs varied widely between models, but on average direct production costs accounted for about two-thirds of the sticker price of a car or truck. The largest single factor was the cost of components, about one-half of a vehicle's sticker price. Final-assembly operations accounted for about 10 percent of a vehicle's sticker price, development costs another 5 percent.[19] Manufacturers also added a destination charge of about 2 percent, although the figure bore little relationship to actual shipping costs.

The other one-third of a vehicle's sticker price—the portion attributable to indirect costs—was added after the vehicle was fully assembled and ready to drive. About 15 percent of the sticker price went to the dealer. The dealer and producer together absorbed the cost of advertising, approx-

imately 5 percent of the sticker price. Producers added about 5–10 percent to the sticker price for administrative costs, such as central management, not attributable to the direct production of any particular vehicle. Finally, manufacturers over the long run returned about 5 percent of the typical vehicle's sticker price to the shareholders as dividends.

Final Assembly. In 2000 cars and trucks were assembled at fifty-six final-assembly plants in the United States. General Motors operated twenty-three of the fifty-six plants, and Ford, sixteen. The other seventeen U.S. final assembly plants were managed and owned—either partially or entirely—by foreign companies, including ten owned by DaimlerChrysler.

Two-thirds of the vehicles sold in the United States in 2000 were produced at the fifty-six U.S. assembly plants, while the remaining one-third were assembled in other countries. Vehicles sold in the United States but assembled elsewhere came from four areas: Canada, Mexico, Europe, and East Asia. Canadian factories assembled 15 percent of the vehicles sold in the United States in 2000; Mexican plants, 4 percent; East Asian (primarily Japanese and South Korean), 11 percent; and European (primarily Germany and Sweden), 4 percent. General Motors assembled in the United States about 80 percent of the vehicles it sold in the United States; Ford, about 75 percent; DaimlerChrysler, about 60 percent; Honda, about 55 percent; and Toyota, about 50 percent.

Foreign-owned, final-assembly plants built in the United States and Canada during the 1980s and 1990s were known as transplants and were responsible for much of the confusion in distinguishing between American and foreign cars. High distribution costs had traditionally led manufacturers to locate final-assembly operations in the country where the vehicles would be sold. Ford and General Motors pioneered the construction of final-assembly plants in other countries early in the twentieth century.

An essential element in the strategy of assembling vehicles where they are to be sold is sufficient demand for the product in the local market to justify capital expenditures of more than $1 billion to construct the final-assembly plant. In the late twentieth century annual capacity of a typical final-assembly plant, operating with two shifts and no overtime, was approximately 200,000 vehicles per year. Thus a manufacturer considered dedicating a final-assembly plant to a particular product when projected demand for the product approached the capacity level. Among builders of transplant factories in North America, only Honda, Nissan, and Toyota had achieved this level in 2000.

Honda, the first Asian car maker to build North American transplants in the early 1980s, operated assembly plants in Marysville and East Liberty, Ohio, Alliston, Ontario, and Lincoln, Alabama. Faced with limited prospects for increasing sales in its home market of Japan, Honda moved more aggressively than the other Japanese companies to establish overseas final-assembly operations. The company sold more than twice as many cars in North America as in Japan during 1992, and became the leading exporter of cars from North America. Toyota built assembly plants in Georgetown, Kentucky (with two lines), Cambridge, Ontario, and Princeton, Indiana.

Parts. Vehicles assembled in the United States contained mostly American-made parts. Ford and GM imported about 10 percent of their parts from countries outside the United States, all but a handful from Canada and Mexico. Vehicles assembled in the United States by Honda contained mostly American parts because the company made its engines at a plant in Anna, Ohio, and its transaxles at a plant in Russells Point, Ohio. Toyota built engines at plants in Georgetown, Kentucky, and Buffalo, West Virginia, but imported transaxles.

Sensitive to the large trade imbalance between the United States and Japan, Japanese-owned assembly plants in the United States tried to purchase as many parts as possible from suppliers with U.S. plants. Japanese-owned and -managed U.S. assembly plants purchased about $25 billion of parts in 1997, an increase from $3 billion ten years earlier. Included in the $25 billion total was about $3 billion in engine parts, $5 billion in chassis parts, $8 billion in body parts, $6 billion in electrical parts, and $3 billion in other parts. These purchases represented about half of the parts needed at the foreign-owned assembly plants, leaving the other half to be imported.

Information about the national origin of components came from data filed with the U.S. Foreign Trade Zones Board. All but a handful of U.S. final-assembly plants were designated "foreign trade zone subzones," as were hundreds of factories in other industries. The Foreign Trade Zones Board's annual reports recorded the movement of merchandise in and out of every subzone during the previous fiscal year, including the value of domestic and foreign purchases and domestic and foreign sales. Components made in Canadian and Mexican factories were counted as domestic.

Vehicle producers sought "foreign trade zone subzone" status for their final-assembly plants to reduce and delay duties paid on imported parts. The import duty on most motor vehicle parts was 6.9 percent, while the duty on most finished vehicles was only 2.5 percent. Final-assembly plants

located in foreign trade zone subzones were charged the lower rate for their imported parts, and they could delay paying the duty until after the vehicle was completed and shipped rather than paying it when the parts were received.

The percentage of domestic components used at the Japanese assembly plants in the United States was overstated in the reports of the foreign trade zone subzones. The problem was that the Foreign Trade Zones Board considered a component to be entirely domestic if at least 50 percent of its value was added in the United States. However, many components obtained from suppliers in the United States actually contained a large percentage of imported material.

Research and Development. The cost of developing an entirely new model was typically measured in the billions of dollars. DaimlerChrysler spent approximately $1 billion in the early 1990s to develop its large LH cars (sold under such names as Dodge Intrepid and Chrysler Concorde) and $1.6 billion to develop its subcompact Neon model. Ford spent $6 billion to develop its compact car, sold in Europe as the Mondeo and in North America as the Contour and Mystique. General Motors spent $4.5 billion to develop its first Saturn car.[20] When the development cost for a particular model is divided by the total number of that model the company expected to sell, the development cost per vehicle is seen to exceed $1,000.

GM, Ford, and DaimlerChrysler maintained major centers in the Detroit area for research, development, and testing of new models. Foreign companies did most of their preparation of new models abroad, although they maintained design and testing centers in the United States. Japanese companies placed most of their U.S. design studios in southern California rather than in the Detroit area. California was by a wide margin the leading regional market for Japanese vehicles, but its principal attraction was its reputation as the locus for the development of new American popular culture trends. To develop vehicles more appealing to import buyers, Ford relocated its Lincoln design studios to southern California as well. Several Japanese firms joined the domestic companies in locating engineering and evaluation facilities in the Detroit area, in part for proximity to the headquarters of leading parts suppliers.

Shipping. Buyers of new vehicles in North America were aware that a several-hundred-dollar "destination charge" appeared on the sticker, rather than being incorporated into the advertised price, as was the case

for most other products. Until the 1950s the destination charge was based on the cost of shipping assembled vehicles from the manufacturer's home assembly plant in Michigan. A 1954 Chevrolet, for example, carried a destination charge of $279 in Seattle, $145 in Houston, $74 in New York, and $11 in Detroit—in each case, about 12¢ per mile from the GM division's "home" assembly plant in Flint.

Customers outside the Midwest objected to paying the higher destination charges, because the vehicles they bought were actually assembled not in Flint but at branch plants in nearby cities, such as Los Angeles and the San Francisco Bay area. The large variation in destination charges led to widespread "bootlegging" during the 1950s, especially on the West Coast. Enterprising used car dealers paid for teenagers to drive old vehicles to Detroit, buy new cars at Detroit showrooms, and drive them back west, where they could be profitably sold at a lower price than comparable models in the new car dealer showrooms carrying the higher destination charges. The teenagers got to see the country and put a couple of thousand miles on a brand-new car. One-fifth of vehicles sold in California during the early 1950s were "bootlegged" in this way.[21]

Faced with congressional pressure to help West Coast dealers and eliminate bootlegging, the car makers revised their destination charges several times during the 1950s. Maximum destination charges were lowered, though list prices were raised to offset the loss of revenue. In effect, westerners paid less and midwesterners more for their vehicles. GM did not adopt a uniform freight charge throughout the continental United States until the 1982 model year.[22]

National Origin of Indirect Costs

The one-third of a vehicle's sticker price accounted for by indirect costs could be divided between those costs incurred in the country where the manufacturer's corporate headquarters were based and those incurred in the country where the vehicle was sold. Dealer and marketing costs were spent overwhelmingly in the country where the vehicle was sold, while administrative overhead and shareholder profits were spent in the manufacturer's headquarters country.

Central Administration. Executives and shareholders with only a few exceptions reside in the country where the company originated, even if production facilities have since been located in other countries. Ford and General Motors were considered American companies because their corporate

headquarters were located in or near Detroit. Volkswagen was considered a German company because its headquarters were in Wolfsburg, and its shareholders were overwhelmingly German. Toyota's headquarters were located in Nagoya, Japan, while other Japanese firms with North American assembly plants were based in the Tokyo metropolitan area. Japanese manufacturers sold about twice as many vehicles in Japan as in the United States but employed ten times more people in Japan than in the United States.

Corporate Profit. Because motor vehicle manufacturers are corporations with publicly traded shares, the names of their major stockholders are a matter of public record. Most shares are held by financial institutions, such as banks, insurance companies, and investment firms, which have invested on behalf of pension and mutual funds. The one exception is the Ford Motor Company, which was owned entirely by the Ford family until 1955, when shares were offered to the public. Family members still controlled about one-third of the company's voting stock in 2000.

The major investing financial institutions are based in the same country as the corporate headquarters of the manufacturer. An individual mutual fund investor or pension recipient could be from any country, but most are citizens of the country where the investment firm is based. Thus, shares in Ford and General Motors are held primarily by American financial institutions and American citizens, DaimlerChrysler by German financial institutions and German citizens, and Honda and Toyota by Japanese financial institutions and Japanese citizens. Several banks and insurance companies held shares in more than one Japanese car maker, creating a tangled pattern of ownership.[23]

Immediately after Daimler-Benz bought Chrysler, DaimlerChrysler could be regarded as only slightly more than half German, because nearly half of the shareholders were American, and although its headquarters are in Stuttgart, Germany, the merged company retained a large administrative operation in Detroit. However, within two years only one-fourth of shareholders were American, and decisions were made in Germany.

Advertising. Some indirect costs were incurred in the country where the vehicle was sold. Most notable were marketing and advertising costs, which averaged $1,000 per vehicle in 2000. Individual dealers, as well as associations of dealers in a region, also contributed to the advertising budget.

Regardless of where they manufactured their vehicles, companies selling in the United States hired U.S. advertising agencies and placed advertisements on U.S. television and in U.S. newspapers. Advertisements featured the language and images appropriate for American consumers, and the same advertisements were rarely used in other countries. For a U.S. advertising agency, a contract to create advertising for an automotive firm was typically its principal source of prestige, as well as its largest source of revenue.

Dealer Expenses and Profit. A motor vehicle dealer was an independent business, invariably owned by a resident of the country where the vehicle was sold. Foreign ownership of motor vehicle dealers was rare. Given the high cost of advertising and operating dealerships, one-fifth of a vehicle's suggested retail price might be spent in the United States, even if the vehicle was entirely manufactured abroad. A principal dispute surrounding the distinction between "American" and "foreign" vehicles concerned this one-fifth of the sticker price. Japanese-owned companies included these substantial indirect costs to demonstrate their contributions to the U.S. economy. American-owned companies claimed that the same advertising and dealer-related expenditures would be spent in the United States if the imports were replaced with vehicles manufactured in the United States.

Caring about National Origin

The national origin of vehicles sold in the United States by Ford and General Motors can be compared to those of Honda and Toyota (Table 11.1). The distinction between American and foreign vehicles may have been blurred by 2000, but it had not disappeared. Roughly 90 percent of the value of the vehicles sold in the United States by Ford and GM in 2000 could be identified as U.S. content, compared to less than one-half of the value of vehicles sold in the United States by Honda and Toyota.

Ford and GM conducted nearly all of their research and development activities in the United States, compared to only token studies conducted by the Japanese companies. Nearly all components attached to vehicles sold in the United States by Ford and GM were manufactured in North America, compared to one-third of the components attached to vehicles sold in the United States by Japanese companies. Ford and GM assembled more than three-fourths of their vehicles in North America, compared to just over one-half of the Japanese vehicles sold in the United States.

TABLE 11.1. Domestic Content of Vehicles Sold in the Unites States in 2000

Type of Expense	% of Expense in Total Retail Price	Vehicles Sold in U.S. by Ford & GM	Vehicles Sold in U.S. by Honda & Toyota
Direct costs			
Research & development	5	99	10
Components	50	95	63
Final assembly	10	75	100
Shipping	2	98	100
Indirect costs			
Central management	10	99	5
Corporate profit	5	99	8
Marketing	5	100	100
Dealer expense	13	100	100
Percent U.S.-made			
All factors	100	97	63
Excluding marketing & dealer	82	96	54

Source: Estimated by the author from multiple sources.

Virtually all shipping costs incurred by Ford and GM were in North America, compared to about one-half for the Japanese firms. Virtually all Ford and GM central management and overhead expenses were spent in the United States, compared to a very small percentage for the producers with headquarters in Japan. Virtually all profits enjoyed by Ford and GM were distributed to shareholders located in the United States, while Americans owned less than 10 percent of the Japanese firms.

The considerable expenses associated with marketing and operating dealerships were spent in the country in which the vehicles were sold. These two expenditures nearly doubled the percentage of the sticker price of vehicles sold in the United States that Japanese firms spent in the United States.

Evelyn Y. Davis was a well-known figure at annual stockholders' meetings during the 1990s, a diminutive woman in her 60s with a powerful voice who owned small quantities of shares in many companies so that she could speak her mind during the time available for questions and comments from the audience. At Chrysler Corporation's last annual share-

holders' meeting, Ms. Davis, who owned 500 shares, unleashed a torrent of outrage at Chrysler officials for selling out to Daimler-Benz, a company that had done business with the Nazis. She spoke as a survivor of the Holocaust: as a teenager she had been sent to a concentration camp. Robert Eaton, Chrysler's chairman at the time of the merger, responded to Ms. Davis that his own wife had never known her father, because he had died during the Allies' 1944 D-Day landing at Normandy, three weeks before her birth.

Daimler-Benz produced armaments for the Nazis during World War II, including tanks, trucks, and aircraft engines. With their workers off serving in the German army, Daimler-Benz, like other large German companies, faced a severe labor shortage. To maintain production, the German government "loaned" as replacement workers Jews and Poles, who were paid 3 marks a day to do the worst jobs. As soon as fresh replacements were sent in, exhausted Jews and Poles were sent off to the concentration camps. According to a history of Daimler-Benz, "in pursuit of their own interests, companies actively participated in the exploitation of foreign, concentration camp and Jewish labor, in 'Aryanization' policies and in the exploitation of the occupied territories. Daimler-Benz was no exception here."[24]

The author Cynthia Ozick told the *Wall Street Journal* at the time that she herself avoided German products as a "private memorial" to Holocaust victims, and therefore would not buy a Chrysler product. "This is irrational and not particularly moral. But I have to make some marker in my life."[25]

The Motor Vehicle Manufacturers Association (MVMA) represented producers from the early years of the industry. When foreign companies began production in the United States, they naturally joined the MVMA. Because of serious differences in objectives between the Big Three and foreign companies on such issues as import tariffs and quotas, the Big Three dissolved the MVMA in 1992 and formed a U.S.–only lobbying group, the American Automobile Manufacturers Association (AAMA). Foreign companies in turn created their own organization, the Association of International Automobile Manufacturers. But when Daimler-Benz bought Chrysler, the AAMA lost one of its three members, so it was no longer a viable organization. U.S.–owned vehicle producers again joined with foreign companies in a single organization, the Alliance of Automobile Manufacturers, created in 1998. Differences in approaches to international trade may have still divided domestic and foreign companies, but shared objectives became more important than differences.[26]

Manufacturers like to think that nationality no longer matters in the production and sale of motor vehicles. That it happens to be incorporated under the laws of the United States, Germany, or Japan is incidental to the companies' global strategies. In reality, nationality still influences the market share held by various companies in more developed countries. A U.S.–owned company has always held the largest market share in the United States, and the same is true for other developed nations. Still, no GI fighting Japan and Germany during World War II could envision that a half-century later Japanese companies would control one-fourth of the U.S. automotive market and German companies another one-fifth. Even if the national origin of a vehicle could be identified, the question was whether anyone cared. Only sixty-five stockholders showed up at Chrysler's last annual meeting to hear Ms. Davis denounce the Daimler-Benz takeover.

12 . . . *To a Global Market*

The Chinese auto industry is just at the beginning stage of development, and there is no necessity to worry about some of the problems that will crop up in the future.

—Ji Xuecheng, general manager, Tianjin Automotive Industry Corporation

Global leadership in the motor vehicle industry in 1900 rested in Europe, especially in Britain, France, and Germany; within a decade, the United States would move ahead to dominate production and sales of motor vehicles. Neither the Ford Motor Company nor General Motors existed in 1900; within a decade, the two would become the world's dominant producers.

Ford and General Motors remained the world's two largest producers through the twentieth century, and the United States remained the world's preeminent car-producing and car-consuming nation. Would the first decade of the twenty-first century bring changes on a scale not seen since the first decade of the twentieth?

For most of the twentieth century the motor vehicle industry was fragmented into a collection of isolated national markets. The only large market for motor vehicles during the first half of the century was the United States, which contained 5 percent of the world's population but in 1950 produced three-fourths of the world's vehicles and owned two-thirds of them. Motor vehicles outnumbered households in the United States by mid-century, and outnumbered licensed drivers by century's end.

Western European countries and Japan joined the United States in the mid-twentieth century to form a collection of national markets, all with distinct traditions of production and sales. Motor vehicles did not outnumber households in Europe and Japan until the end of the century, fifty years later than in the United States. In 2000 North America, Western Eu-

rope, and Japan, which together had 15 percent of the world's population, produced three-fourths of the world's vehicles and owned two-thirds of them.

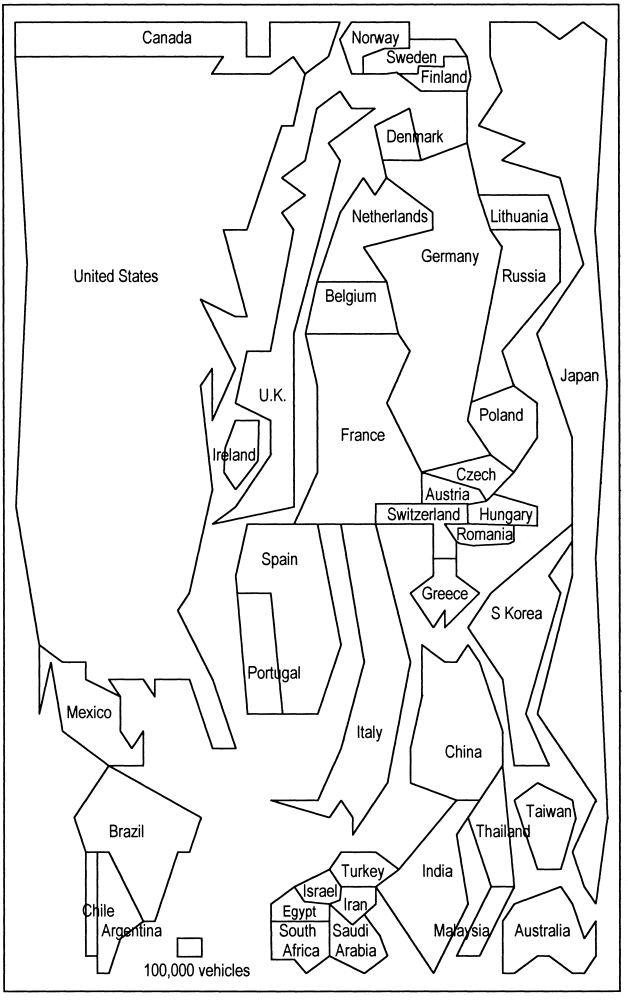
Several Latin American and Asian countries joined the list of distinct national markets during the late twentieth century. National motor vehicle industries were nursed in some of these countries, and by 2000 motor vehicles were common but not yet more numerous than households. The share of world production and sales of motor vehicles in less developed countries increased rapidly during the 1990s, from less than one-tenth to one-fourth. Will motor vehicle ownership become as ubiquitous in these regions during the twenty-first century as it did in North America, Western Europe, and Japan during the twentieth? If so, will mass production once again be responsible for making motor vehicles affordable for most people?

The division of the world into a collection of isolated national markets was swept aside by globalization that began in the last years of the twentieth century. Barriers protecting national markets were dismantled, and surviving manufacturers crossed international borders to acquire competitors (Fig. 12.1).

Selling "National" Cars

In 1983 the government of Malaysia decided to create a national car, called Proton, from the name Perusdahaan Otomobil National Berhad. A government-owned conglomerate called Hicom owned 70 percent of Proton, and the Japanese car maker Mitsubishi, the other 30 percent. The first Proton model was allegedly designed by Mitsubishi officials leaning over the prime minister while he sat at his desk. With a 145 percent tariff making imported vehicles prohibitively expensive, Proton held one-half of Malaysia's market. Banks promoted purchase of Protons by offering ten-year loans requiring only 10 percent down payments.

India also established a national car in 1983, the Maruti, made by Maruti-Udyog Ltd., a joint venture between the government of India and the Japanese car maker Suzuki. Before the development of the Maruti, India's market had been controlled by Hindustan Motors and Premier Automobiles, which produced 1950s-era cars under license. At first the government controlled 74 percent of Maruti, although Suzuki was allowed to increase its stake to 40 percent in 1987 and 50 percent in 1992. Maruti captured more than 80 percent of the Indian market by selling a $6,000



12.1. Car and truck sales by country, 1999. The size of the country is proportional to the number of sales. Only countries with sales exceeding 100,000 in 1999 are depicted.

minicar with an 800-cc engine based on an old Suzuki model. The government of India effectively choked off imports by imposing duties that rose from 15 percent in 1984 to 42 percent in 1989, 52.5 percent in 1990, and 66 percent in 1991.

The national car policies of Malaysia, India, and other developing countries in Asia during the 1980s followed in the tradition of government strategies pursued in earlier decades elsewhere in Asia and Europe. Re-

strictive government policies led to distinctive national motor vehicles in Japan and Europe during the 1930s, in Latin America during the 1950s, and in South Korea during the 1960s. Most of these barriers were removed in the late 1990s.

National Markets in Europe

German and French manufacturers laid claim to have "invented" the motor vehicle long before Americans put working prototypes on the streets. A Frenchman, Joseph Étienne Lenoir, produced the first usable gas engine in 1860 and designed a carriage to be propelled by it. The Germans and the French also claimed to have made most of the early design and technical improvements in motor vehicles during the 1880s and 1890s, before production had begun in the United States. The leading European motor vehicle producers in 2000, with the exception of Volkswagen, had been in business since the late nineteenth or early twentieth century.

The United States soon came to dominate world motor vehicle sales through mass production, while Europe's small-scale producers still crafted luxury vehicles for aristocrats. Heavy taxes on gasoline and large-displacement engines encouraged the development of small cars in Europe, but no company could sell enough vehicles to justify making use of mass production techniques. The largest European companies struggled to sell 100,000 vehicles a year during the 1920s and 1930s, at a time when the Big Three U.S. companies were each producing more than 1 million a year.

Europe became fragmented into a collection of distinct national markets, with dozens of producers, each operating essentially in one country. The major European governments solidified their isolated national markets during the 1930s through quotas, high tariffs, and limitations on the ability of corporations to move capital, dividends, materials, and employees across international boundaries. German import policies were especially severe after the Nazis took power in 1933. Vehicles sold in Germany had to have at least 95 percent German-made parts, and the parts had to be interchangeable among all companies producing and selling in Germany.

At the outbreak of World War II, the United States had 30 million vehicles, while Western Europe, with a larger population and comparable levels of wealth and industrial output, had only 8 million, including 2.6 million in the United Kingdom, 2.3 million in France, and 1.5 million in Germany. The devastation of World War II and lower living standards following the war further retarded the growth of Europe's motor vehicle market until the 1950s. Production rose in Western Europe from 2 million

in 1950 to 6 million in 1960 and 12 million in 1970. Europe's share of world production rose from 15 percent in 1950 to 37 percent in 1960 and 40 percent in 1970.

Consolidation of Europe's large number of low-volume manufacturers contributed to the growth in production during the postwar period. Five of the United Kingdom's six largest producers merged into one company, three of Germany's six largest into one, and three of France's five largest into one. The handful of surviving companies were able to take advantage of mass production to produce large volumes of small cars suitable for their particular national markets. Volkswagen held about one-third of the German market; Peugeot and Renault, about one-third each of the French market; and Fiat, about one-half of the Italian market.

In Germany, production of Volkswagen, Hitler's "people's car," started in 1937 in a Wolfsburg factory laid out by Dr. Ferdinand Porsche, although only a handful of VW cars were built before World War II. After the war the West German government controlled the factory until 1960, when it sold 60 percent of the stock to the public. Ford considered but rejected buying 51 percent of Volkswagen in the late 1940s.[1]

Daimler-Benz held only 10 percent of the overall German market, but dominated luxury car sales. The company was formed through the merger in 1926 of Benz & Company and Daimler Motoren Gesellschaft. Carl Benz had made the first authenticated tests of a vehicle with three wheels and a one-cylinder gasoline engine in 1885, patented it in 1886, started sales in 1887, and built a four-wheeled vehicle in 1893. Gottlieb Daimler had designed a four-cycle, gasoline-powered engine in 1883, two years earlier than Benz. He received the first German patent on a three-wheeled, gasoline-powered vehicle in 1885, but started manufacturing vehicles three years later than Benz, in 1890.

Volkswagen consolidated its position as Germany's leading producer by acquiring Auto Union GmbH in 1964 from Daimler-Benz, which had bought it six years earlier. Auto Union was formed in 1932 through the merger of Audi, Horch, DKW, and Wanderer. The brand's symbol of four interlocking rings represented the merger of the four car makers. NSU, a major motorcycle manufacturer, merged with Auto Union in 1969 to form Audi NSU Auto Union AG, renamed Audi AG in 1985.

Renault, founded in 1899 by Louis Renault and his brothers Marcel and Fernand, became France's leading car maker by building small vehicles, when other pioneering French companies were building large, expensive ones. For example, De Dion-Bouton & Trépardoux pioneered production

of steam-powered vehicles in 1883 and in 1894 won the world's first important race, from Paris to Belfort. The company switched to gasoline engines in 1893 and went out of business in 1903.

René Panhard and Émile Levassor, owners of a woodworking and carriage factory in Paris, built the first "modern" motor vehicle, which they started selling in 1892. Instead of building a modified horse-drawn carriage, Panhard & Levassor mounted a Daimler engine in the front rather than under the driver and replaced a belt drive with a sliding gear transmission and differential that transmitted power by a chain drive to the rear axle. Levassor died of injuries sustained in a race in 1897.

Armand Peugeot built his first motor vehicle in 1885 in the family-owned bicycle shop and five years later founded the motor vehicle production company bearing his name. In 1976 Peugeot took over Citroën S.A., which had started producing motor vehicles in 1919, after having been founded by André Citroën to manufacture armaments during World War I. Citroën S.A. went bankrupt in 1934, André Citroën died in 1935, and the car maker was sold to the Michelin Tire Company in 1936.

Peugeot became France's sole surviving privately owned vehicle producer in 1979, when it acquired Chrysler's European operations. Chrysler had acquired the French company Simca and the British Rootes Motors Ltd. (later called Talbot by Peugeot) during the 1960s. Simca had become a major vehicle producer in France during the 1930s, then expanded by acquiring Ford's French production facilities in 1958. Rootes had combined Hillman and Humber to form one of Britain's six major motor vehicle producers between the 1930s and 1950s.

The French government took control of Renault in 1945 at the end of World War II. Half a century later, in 1994, it sold 49.9 percent of the company to private investors. Renault acquired a controlling interest in American Motors in 1980, but was unable to make a profit. In 1987 Renault sold AMC to Chrysler, which then turned the company's Jeep brand into a major success.

Fiat S.p.a., Italy's dominant producer through the twentieth century, was founded in Turin in 1899 by Giovanni Agnelli, who ran the company until 1945. (The name "Fiat" is an acronym for Fabbrica Italiana Automobili Torino.) Fiat produced more than 80 percent of the motor vehicles sold in Italy before World War II, protected by a 300 percent duty on imported cars—high even in comparison to the highly restrictive practices in the rest of Europe at that time. A supporter of Mussolini and leader of

Italy's industrial production during World War II, Agnelli was removed from control of Fiat after the war. Under government ownership, Fiat maintained its position of near monopoly in Italy, and the Italian government restored ownership to Agnelli's children in 1966.

In the United Kingdom, British Leyland Motor Corporation was created in 1968 through the merger of British Motor Corporation (BMC) and Leyland Motor Corporation Ltd. BMC itself was the product of a 1952 merger between two pioneering British car producers: Austin Motor Company Ltd., founded in 1905 by Herbert Austin, and Morris Motors Ltd., founded in 1910 by William Richard Morris, later known as Lord Nuffield. Austin and Morris produced two-thirds of Britain's cars during the 1920s, but lost their dominant positions during the 1930s. The 1952 merger placed BMC as one of two market leaders in Britain, a position it maintained through many subsequent mergers, especially after introduction of the tiny Mini car in 1959.

Leyland Motors Ltd. had been established in 1907 to manufacture commercial vehicles, which the British called lorries. Leyland concentrated on truck production until 1961, when it acquired Standard Triumph Motor Company Ltd., which had begun in 1903 as a motorcycle manufacturer and had begun making cars in 1923. Leyland merged in 1966 with the Rover Company Ltd., which had been making bicycles since 1884 and cars since 1904. Triumph was especially known for its small, affordable sports cars, Rover for conservatively styled sedans favored by doctors and other professionals.

Ford and General Motors were the only two car makers selling large numbers of vehicles in more than one country during the first half of the twentieth century. Both began to put together knocked-down kits of U.S.–designed cars—especially Ford's Model T and GM's Buick and Chevrolet—at plants in several European countries during the 1910s and 1920s. During the 1920s the two companies added plants to assemble U.S.–designed cars elsewhere in the world, including Argentina, Australia, Brazil, and Mexico. Some countries were served by the export of vehicles from the United States, but both GM and Ford favored a policy of "build where you sell" wherever possible.[2]

Ford and GM restructured their European operations when restrictive trade practices swept across Europe during the 1930s. The region's narrow roads, combined with high taxes on gasoline and large-displacement engines, made American-designed cars no longer suitable for the European

market. Ford's and GM's British and German operations gained considerable autonomy to design, build, and sell cars in those countries. Europeans soon came to regard Ford and GM as predominantly British and German car makers rather than American.[3]

Under the leadership of its long-time European executive, Sir Percival Perry, Ford developed a plan back in 1928 to Europeanize its operations. Ford's British base was a massive factory complex opened in 1931 at Dagenham, east of London, on the north bank of the River Thames. Emulating Ford's Rouge complex, Dagenham generated its own power, processed raw materials, produced components, and assembled distinctive cars primarily for the British market, then the world's second-largest, behind the United States. Ford shot to first place in Britain and remained first or second through the rest of the twentieth century, with about one-fifth of the British market. Ford brands were so popular in Britain that in Douglas Adams's best-selling 1979 book *The Hitchhiker's Guide to the Galaxy,* the leading character, an alien from Betelgeuse living in England, called himself Ford Prefect, mistaking it as a "nicely inconspicuous" name for an Englishman. Faced with uncompetitively high production costs, Ford announced closure of the sprawling Dagenham complex in 2001.

With its tradition of self-contained raw materials handling and parts making, Ford in Germany had difficulty meeting the Nazis' demands for interchangeable parts. But the company did design and assemble a distinctive car for the German market in an assembly plant at Cologne that had formerly put together vehicles from parts imported from Britain and the United States. The Cologne plant was destroyed during World War II and rebuilt after the war.

General Motors also concentrated production facilities in Germany and the United Kingdom before World War II. Typically, while Ford built the massive Dagenham complex, GM became a major player in Europe by acquiring two companies, the British Vauxhall Motors in 1925 and the German Adam Opel AG in 1929. Five Opel brothers had begun making cars in 1899 in the factory built by their father, Adam Opel, in Russelsheim in 1862 to make sewing machines. The economic uncertainty, including hyperinflation, in Germany during the 1920s induced the family to sell 80 percent of the company to GM in 1929, the remaining 20 percent two years later. Vauxhall Iron Works, named for a neighborhood in London, began large-scale motor vehicle production in 1903. Vauxhall lost its distinctiveness in the 1970s, when it became an Opel rebadged for the British market.

Japan and South Korea Subsidize Domestic Producers

Toyota and Nissan, destined to become Japan's two leading vehicle producers, were founded during the 1930s primarily to supply the army. Toyota traced its origin to Toyoda Spinning and Weaving, established in 1897 in Nagoya. The company's Toyoda Automatic Loom Works built motor vehicles beginning in 1929 and components in 1933. A Motor Vehicle Division was formed within the Automatic Loom Works in 1933 and reorganized as a separate company in 1937. Nissan was founded in Yokohama in 1933 by an entrepreneur, Yoshisuke Ayukawa, with engineering provided by an American expatriate, William R. Gorham.

Before the growth of Toyota and Nissan, Japan's two dominant motor vehicle producers in the 1920s and early 1930s were Ford and General Motors. Ford opened an assembly plant in Yokohama in 1925, and GM opened one in Osaka two years later. Over the next decade Ford held about one-half of the Japanese market, GM about one-third.

Preparing for war during the 1930s, the Japanese government forced the American companies first to limit production and then to shut down. The 1936 Motor Vehicle Industry Development Act imposed heavy tariffs on imported vehicles and engines. The 1939 Military Motor Vehicle Act limited production to military and government vehicles. Ford and GM terminated Japanese production, leaving the field to Toyota and Nissan.

Japan's motor vehicle industry was rebuilt after World War II with government support. Most critical was the Ministry of International Trade and Industry (MITI), which announced a five-year plan in 1955 for development of a domestic passenger car industry. MITI provided access to capital for investment in new technology, plants, and supporting industries, such as parts suppliers and shippers. As a result, production jumped from 69,000 in 1955 to 111,000 in 1956 and 182,000 in 1957. New companies began producing motor vehicles: Suzuki in 1955, Fuji Heavy Industry (Subaru) in 1958, New Mitsubishi Heavy Industry in 1960, and Toyokogyo (later Mazda) in 1960. Domestic sales increased rapidly during the next three decades to a peak of 7 million in the early 1990s.

Japan eliminated tariffs in 1978, but still discouraged imported vehicles through a higher sales tax on vehicles with large engines, and an extra consumption tax for all vehicles with engines over 600 cc. Importers even found it difficult to place their vehicles in showrooms, because Japanese manufacturers provided subsidies to dealers to retain their loyalty.

Rather than using tariffs, Japan discouraged imports primarily through

laws known as "homologation," which subjected imported motor vehicles to expensive alterations and inspections to conform to local standards. For example, primarily because of homologation, a 1995 Jeep Cherokee costing $19,100 in the United States sold in Japan for $31,372. The additional $12,272 came from the following:

- $1,333 profit for Chrysler because of change in the exchange rate between the dollar and yen
- $200 for shipping by rail from Toledo to Baltimore, applying protective wax coating, adding features required in Japan, including a heat-sensitive dashboard warning light for an overheated muffler, and shipping by sea to Chiba, Japan
- $682 for Japanese customs officials to check for compliance with 238 various regulations
- $1,569, mostly profit, for Chrysler Japan Sales, Inc. to inspect for dents and scratches, and ship by truck to Chrysler distributor Seibu Motor Sales
- $1,100 for Seibu to add more features required in Japan and to pass tests including a five-minute brake test and a twenty-minute test of exhaust levels
- $1,925, mostly profit, for Seibu to again inspect for scratches; attach separately shipped parts, such as floor mats and cigarette lighter; remove protective shipping wax; polish; and install $200 worth of optional equipment
- $5,463, mostly profit for the dealer[4]

Meanwhile, Japan's protected producers were encouraged to expand through increased exporting. Exports grew from a few thousand a year during the 1960s to 2 million per year during the 1970s and 7 million per year during the 1980s and 1990s. One-fourth of Japan's exports during this period went to North America, one-fourth to Europe, and one-half elsewhere, especially in Asia. When governments in North America and Europe sought mandatory or voluntary limits on vehicle exports from Japan, Japanese companies invested in overseas factories to serve those markets. Honda grew from a minor motorcycle manufacturer to a major motor vehicle producer largely on its strength in exporting and then producing overseas.

South Korea emulated the Japanese model closely. The Korean government selected a handful of large, domestic conglomerates, known as *chae-*

bols, to produce motor vehicles. Hyundai Motor Corporation, the *chaebol* destined to become Korea's dominant motor vehicle producer, was founded in 1947 by Chung Ju Yung. Started as the Hyundai Land and Construction Company, the firm began producing motor vehicles in 1967 and exporting them in 1973. Hyundai produced its first Korean-designed car in 1975, with a Mitsubishi engine.

Daewoo Industrial Company Ltd., a *chaebol* established in 1967 as a textile producer, entered heavy industry and shipbuilding during the 1970s at the request of the Korean government. Daewoo got into motor vehicle production in 1978 by acquiring from the Korea Development Bank a 50 percent interest in the Shinjin (Saehan) Motor Company, which had started in 1965. Korea's third vehicle producer, Kia, started making bicycles in 1944, motorcycles in 1961, three-wheel trucks in 1962, four-wheel trucks in 1971, gasoline engines in 1973, and passenger cars in 1974.

Like Japan, South Korea had no local content requirement or import limits, but taxed larger vehicles, such as those made in the United States, at higher rates. However, Korea did ban imports of motor vehicles from Japan, a legacy of the Korean reaction to Japanese military aggression during the 1930s and 1940s.

Trade Barriers in Latin America

The two largest Latin American markets, Mexico and Brazil, emulated the European and East Asian strategies of cutting off imports. Lacking Europe's pioneering car makers or East Asia's willingness to underwrite new car makers, Latin America turned over its motor vehicle industries to established firms from the United States, Europe, and Japan. However, Mexico and Brazil both erected strict domestic-content rules during the 1950s that choked off imports and required foreign producers to build production facilities in those countries instead.

Ford put together the Model T in a rented garage in Mexico City beginning in 1925 and opened its own assembly plant at La Villa in 1932. GM started to assemble trucks in 1935 at a Mexico City plant. A Mexican-owned company, Fábricas Auto-Mex, assembled Chrysler cars beginning in 1938. These three companies held about three-fourths of the Mexican market during the 1950s. Several American, European, and Mexican companies split the remaining one-fourth of the market.

The Mexican government identified two problems with its auto industry during the 1950s. First, the Mexican market—about 50,000 vehicles a year—was too small to justify the number of products and assembly

plants; the country needed fewer, more efficient plants producing fewer products in larger batches. Second, nearly all of the vehicles were assembled as knocked-down kits—that is, with all of the parts imported. If the parts were produced domestically, the auto industry would generate more jobs in Mexico.

The Mexican government's "Integration Decree" of 1962 called for reducing the number of manufacturers to four or five. In fact, seven companies assembled cars in Mexico during the 1960s and 1970s: Chrysler (which acquired Fábricas Auto-Mex in 1971), Diesel Nacional (which assembled Renaults), Ford, GM, Nissan, Vehiculos Automotores Mexicanos (which assembled American Motors cars), and Volkswagen (which acquired Promexa). The 1962 decree also required that 60 percent of the parts in vehicles assembled in Mexico had to be produced in Mexico, and these parts suppliers had to have at least 60 percent Mexican ownership. Jobs in the Mexican motor vehicle industry increased from 8,000 in 1962 to 40,000 in 1977. Assembly and engine plants were opened by Ford at Cuautitlán in 1962, by Chrysler at Toluca in 1964, by Volkswagen at Puebla in 1966, and by Nissan at Cuernavaca in 1966. GM opened an assembly plant at Mexico City in 1964 and an engine plant at Toluca in 1963.

Rising prices for Mexican oil during the 1970s brought about a boom in automotive assembly in Mexico, from 136,712 cars in 1970 to 355,497 in 1981. Declining oil prices then knocked Mexican production down to 207,137 cars in 1983. Vehiculos Automotores Mexicanos stopped producing cars in 1983; Renault, in 1986. Volkswagen stayed in business in Mexico by becoming the country's largest exporter of coffee.

Brazil remained entirely dependent on imported vehicles until 1956, at which time it encouraged domestic production by slapping high tariffs on imported vehicles and requiring that vehicles assembled in Brazil contain at least 90 percent parts made in Brazil. The first producer, Alfa-Romeo, opened a truck plant as a joint venture with the Brazilian government in 1957. Ford, General Motors, and Volkswagen soon followed. The protected Brazilian market increased steadily through the 1960s and 1970s, to a peak of 1.1 million vehicles in 1978, 1979, and 1980.

Brazil's motor vehicle production plunged during the 1980s, when the country was unable to repay more than $100 billion of foreign debts, and its system of indexing prices to inflation produced triple-digit hyperinflation. Car makers operating in Brazil's closed market had little incentive to invest in new plants or models, improve quality, or lower prices. Ford's Falcon, sold in the United States as a 1960 model, was produced with little

change in Brazil from 1961 until 1991. High taxes also contributed to depressed domestic sales; taxes accounted for between one-half and three-fourths of the price of a new vehicle during the 1980s. To survive during a period of hyperinflation and sluggish sales, Ford and Volkswagen combined their Brazil and Argentina operations in 1987 into Autolatina. By closing underused plants and sticking with aging models, Autolatina was able to turn a modest profit for the two companies.

Eliminating National Barriers

The division of the world into a collection of distinctive national markets began to collapse during the 1990s. National economic policies had erected the barriers during the 1930s and 1950s, and national economic policies contributed to the breakdown of national markets during the 1990s. Motor vehicle producers had no choice but to adapt to the inefficiencies of past trade barriers. In contrast, the restructuring of motor vehicle producers under way during the 1990s (described in the first half of this book) was enhanced by elimination of barriers.

In the three major vehicle-producing regions—North America, Europe, and Japan—consolidation extended across national boundaries, leaving a handful of global survivors with blurred national origins. Better to have foreign-owned plants thriving in a global economy than domestically owned plants struggling to survive. With the freedom to import and exports parts and vehicles as needed, foreign-owned producers could tailor products to rapidly growing markets in Latin America and Asia, and fit production in these regions into global strategies.

Surviving Car Makers in Europe

European, Japanese, and Korean car makers survived into the late twentieth century through a complex web of joint ventures and interlocking ownership. With the collapse of trade barriers at the end of the century, car makers were free to buy out joint venture partners and increase shareholding in former competitors from minority stakes to operating control.

Consolidations left four large-volume, European-based motor vehicle producers in 2000. DaimlerChrysler A.G. and Volkswagen A.G. were based in Germany; PSA Peugeot Citroën Group and Renault S.A. were based in France. Volkswagen was the world's fourth-largest producer in 2000. In the 1990s VW was the market leader across Europe, after acquiring the Spanish car maker Seat in 1986 and the Czech car maker Skoda in

1990. DaimlerChrysler had only 3 percent of the European market but was the world's fifth-largest vehicle producer worldwide in 2000, largely on the strength of North American sales following its acquisition of Chrysler. Renault vaulted into sixth place among global producers by taking over Nissan in 1999.

Production in Western Europe increased from 12 million to 17 million vehicles between 1970 and 2000. Accounting for one-half of the European growth during the late twentieth century was Spain, where production increased from 500,000 in 1970 to 3 million in 2000. Most of the remaining growth was in Germany, where production increased from 4 million in 1970 to 6 million in 2000, primarily by adding output in the former East Germany that had been previously counted separately. Several European manufacturers opened assembly plants in Spain to produce smaller cars, taking advantage of the lower wage rates there than in northern Europe.

Key to free trade within Europe was creation of the European Economic Community (EEC) in 1958 among three major vehicle-producing countries—France, Germany, and Italy—plus Belgium, Luxembourg, and the Netherlands. The European Union (EU), successor to the EEC, encompassed fifteen countries in 2000, with the original six joined by Denmark, Ireland, and the United Kingdom in 1973, Greece in 1981, Portugal and Spain in 1986, and Austria, Finland, and Sweden in 1995. Nearly all goods, services, capital, and people could move freely through the member countries. The introduction of the euro in 1999 as the common currency in most EU member nations eliminated most remaining differences within Europe in prices, interest rates, and economic policies.

Despite consolidation of the European auto industry into six major companies, "experts" still saw Europe as having too many motor vehicle producers in 2000. The "logical" candidates for mergers were the two French companies, Peugeot and Renault. Peugeot was the world's seventh-largest producer, but trailed the Big Six in sales by a substantial margin in 2000, and Renault's prospects were shaky. Another likely acquisition target, BMW, had tried to become one of Europe's largest producers in 1994 by acquiring Rover Group PLC, the last British-owned, mass-market manufacturer. In a last-ditch attempt to remain independent, BMW was forced in 2000 to sell Rover, which it could not operate profitably.

Surviving Car Makers in East Asia

Foreign manufacturers had long been encouraged to buy minority interests in Japanese and Korean companies, but not to gain majority control.

Chrysler acquired 15 percent of Mitsubishi in 1971 and owned as much as 24 percent during the 1980s before selling the shares. GM acquired 34.2 percent of Isuzu in 1971, an amount later raised to 41.6 percent and then reduced to 38 percent. Ford failed to buy 20 percent of Toyo Kogyo (Mazda) in 1972, then acquired 25 percent in 1979. In Korea GM acquired a 50 percent interest in Daewoo. Ford held a 10 percent interest in Kia, and Mazda (one-fourth owned by Ford) had another 8 percent. Mitsubishi (partially owned by Chrysler) owned 15 percent of Hyundai.

Nine manufacturers owned and controlled by Japanese split nearly 100 percent of the market into the 1990s. Only two of the nine—Honda and Toyota—were still independently Japanese-controlled in 2000. During the 1990s control of Nissan was turned over to Renault, Mazda to Ford, Mitsubishi to DaimlerChrysler, and Isuzu, Subaru, and Suzuki to GM. The ninth, Daihatsu, was taken over by Toyota.

The number of Korean-owned car makers dropped from three to one in the late 1990s. Hyundai acquired 51 percent of financially troubled Kia in 1998 and thereby controlled three-fourths of the Korean domestic market. Bankrupt Daewoo was placed on the auction block in 2000. Overexpansion into Eastern Europe after the fall of communism in the early 1990s brought financial ruin to Daewoo.

Opening Markets in Latin America

The largest Latin American and Asian markets replaced protectionism with open markets through a series of reforms during the 1980s and 1990s. Swept away were high tariffs, restrictions on foreign ownership, and government ownership of production. The World Trade Organization ruled that local-content requirements had to be eliminated after 2000.

Facing a trade deficit with the United States and other developed countries, the Mexican government decided to encourage exports during the 1970s. A 1972 decree reduced the local-content requirements from 60 percent to 30 percent for exported vehicles and parts. When exports failed to increase as much as desired, a 1977 decree required each foreign firm operating in Mexico to eliminate its own balance-of-payments deficit within five years. With declining sales in the wake of the oil shortages, the U.S.–owned and European-owned car makers increased investment in Mexico from $31 million in 1978 to $405 million in 1980. Investment in Mexican parts plants nearly tripled between 1976 and 1978. New engine plants were opened by GM in 1979, by Chrysler in 1981, by Nissan in 1982, by Ford in 1983, and by Renault in 1985.

With the collapse of the domestic market in the early 1980s, the Mexican government tried to further stimulate exports. A 1983 decree permitted manufacturers to reduce the number of models produced at their Mexican assembly plants from three to two, and then to just one in 1987. To serve the Mexican market, manufacturers until then had been forced to assemble small batches of a wide variety of models. By rationalizing assembly, manufacturers could achieve the economies of scale that would permit them to operate efficiently in Mexico. The 1983 decree also reduced local-content requirements to 30 percent, as long as at least 80 percent of the output was exported. Ford opened an assembly plant at Hermosillo in 1986 primarily to export small cars to the United States. Two years later Volkswagen closed its U.S. assembly plant and moved all North American production to Mexico.

A 1989 decree pushed up Mexican content to 36 percent.[5] The five companies assembling vehicles in Mexico were allowed for the first time to import up to 20 percent of their Mexican sales, as long as each $1 of imports was compensated by at least $1.75 in exports. Chrysler, GM, and Nissan joined Ford and Volkswagen in building new assembly plants primarily for export: Chrysler at Saltillo in 1995, GM at Silao in 1995, and Nissan at Aguascalientes in 1992.

The North American Free Trade Agreement reduced the required Mexican content for duty-free export from 36 percent in 1994 to 34 percent in 1999 and 29 percent in 2004, as long as each $1 of imports was compensated by 80¢ of exports in 1999 and 55¢ in 2004. Under NAFTA, to qualify for duty-free export from Mexico after 2004, at least 62.5 percent of the content could be made anywhere in North America, with no requirements for compensating imports with a specified amount of exports within North America. Mexican plants could be 100 percent owned by foreigners after 2004.[6]

As a result of the late twentieth-century reforms, Mexico's motor vehicle market was fully integrated with that of the United States. Mexico produced 2 million vehicles and bought 800,000 in 2000. Domestic demand was met with 400,000 vehicles produced in Mexico and 400,000 imported primarily from the United States by DCX, Ford, and GM, and also from Germany by Volkswagen. A total of 1.6 million vehicles were exported from Mexico, primarily to the United States.

Brazil also became an attractive country for car makers in the 1990s. VW and Ford disbanded Autolatina in 1994, and each built new assembly plants. Other companies building new assembly plants in Brazil during the

1990s included Daewoo, DCX, GM, Honda, Renault, and Toyota. Production doubled during the early 1990s, to 2 million in 1997. Some of these new plants experimented with modular assembly and other innovative production methods (see chapter 4).

Brazil's turnaround came after the 1989 elections, when the new government opened the country to imports by reducing tariffs and sales taxes. The Mercosur free trade agreement eliminated trade barriers on parts and vehicles among Argentina, Brazil, Paraguay, and Uruguay. After the government replaced its currency, the cruzeiro, tainted by decades of hyperinflation, with the real, tied to the dollar, inflation dropped from 2,489 percent in 1993 to 3 percent in 1998. Domestic sales boomed when the government's Carro Popular program lowered sales taxes on small cars with engines less than 1 liter.

Brazil's automotive market crashed again during the late 1990s, when production dropped from 2.1 million in 1997 to 1.3 million in 1999, and sales dropped from 1.6 million to 1.2 million. Rising interest rates in 1998 triggered a recession and reduced consumer spending on motor vehicles and other products. The real had to be devalued, causing prices to rise further and increasing the cost of the country's debt repayment to more than half of its gross domestic product. To secure a $41.5 billion loan from the International Monetary Fund, Brazil had to raise interest rates to prop up the currency and limit inflation, and reduce public spending to generate a 3.1 percent budget surplus.[7]

Opening Markets in Asia

Southeast Asia was the world's fastest growing region for sales and production of motor vehicles in 2000. "National" car companies created during the 1980s lost government protection during the 1990s, and the Association of Southeast Asian Nations (ASEAN) virtually eliminated import tariffs on vehicles with at least 40 percent content from a member country (Brunei, Indonesia, Malaysia, Philippines, Singapore, Thailand, and Vietnam).

The Malaysian government sold its stake in Proton in 1997 to a private businessman, Yahaya Ahmad, who started an ambitious modernization and expansion program. A second assembly plant, Proton City, was begun, and Protons were exported to other Asian countries, even to Europe. Proton bought 80 percent of Group Lotus, the British maker of luxury sports cars, from bankrupt Bugatti Automobili S.p.a. in 1996. But Proton's expansion plans were shelved in 1998 after Yahaya died in a helicopter crash.

In India Maruti's monopoly was challenged by foreign-controlled firms

following an economic liberalization program in 1991. Ford India Ltd., started in 1996, became India's second-largest producer. The joint venture was originally owned 50 percent by Ford and 50 percent by Mahindra & Mahindra Ltd., a firm that began in the late 1940s as a steelmaker, but Ford quickly increased its stake to 78 percent, then to 92 percent. India's third-largest producer, Hindustan Motors, owned by C. K. Birla Group, started a joint venture with GM in 1996 to assemble Opel cars as well as its own outdated 1980s designs. India Auto Ltd., a joint venture of Fiat and Premier Automobiles, produced small Fiat cars.

Asian countries that had not developed national cars during the 1980s expanded production and sales by encouraging foreign investment a decade later. Thailand became one of the world's leading markets for light trucks during the 1990s. Pickup trucks held approximately three-fourths of the market in Thailand because they were priced and taxed at a lower rate than cars.

Annual production in Thailand jumped from less than 100,000 during the 1980s to a peak of 356,000 in 1997. Per-capita income rose from $3,000 to $6,400 during the decade, fueling domestic demand, which was met by easy credit. Customers had to wait four months to buy vehicles during the 1980s, and two-thirds of them paid cash, but in the 1990s most vehicles were sold on credit with 20 percent down payments.

Several Japanese companies—including Toyota in 1964 and Isuzu and Mitsubishi in 1966—had opened factories in Thailand during the 1960s to assemble vehicles from imported components. Ford, Honda, GM, and other foreign companies joined the Japanese pioneers in opening assembly plants in Thailand during the 1990s. Mitsubishi sourced its entire world production of 1-ton pickups in Thailand. Thailand's central location kept shipping costs relatively low, and the country had the region's best support of infrastructure and parts suppliers. Six hundred parts plants were built, mostly by the large Japanese and American suppliers attracted by tax breaks.

In the 1990s the Thai government substantially reduced tariffs on vehicles that were imported or assembled with imported components. The Automobile Industry Development Committee (AIDC), established in 1969, set tariffs, local-content requirements, and other protectionist measures. To encourage a larger domestic components industry, the AIDC in 1974 set a tariff of 120 percent on vehicles other than those assembled with at least 25 percent Thai-made components. The tariff was reduced to 20 percent during the 1990s.

The Philippines emulated Thailand's policies during the 1990s, but as a much smaller and more remote market, it failed to secure the same level of foreign investment. Japanese brands held nearly the entire market in the Philippines through joint ventures with local companies. Market leader was Toyota, which started a joint venture with the Philippines government in 1988.

Taiwan's two largest producers, Ford Lio Ho (owned 70 percent by Ford) and China Motors Company Ltd. (owned 15 percent by Mitsubishi), each held one-fourth of the market during the 1990s. Most of the other one-half was split about equally among Yulon (or Yue Loong) Motor Company Ltd. (owned 25 percent by Nissan), Kuozui Motors (owned by Toyota), and San Yang (owned by Honda). To stimulate domestic production of vehicles and components, Taiwan banned most vehicles imported from Japan and Korea. A Taiwan company that exported more automotive components to Japan than a government-imposed quota could import vehicles from Japan equal to the value of the exported components exceeding the quota.

Vietnam, a market of only a few thousand vehicles, also began to attract automotive investment. A dozen companies opened plants during the 1990s to divide the country's tiny market, in anticipation of growth during the twenty-first century.

To achieve economies of scale amid Asia's collection of small national markets, several companies developed so-called "Asia cars" that could be produced and sold throughout the region. For example, Honda sold an "Asia car," called the City, that was similar to the Civic sold in Europe, Japan, and North America, but differed from it in several key respects. The City lacked air bags, antilock brakes, a heater, and a rear-window defroster, but in view of the region's high heat and humidity, it offered an extra air-conditioning vent that blew cool air to the rear passengers. In recognition of the region's poor roads, suspension was a simpler strut style instead of the Civic's double wishbone. Because the already poor roads were subject to flooding during the monsoon rains, the City's chassis had a ground clearance 1 inch higher than the Civic, extra seals to keep the chassis out of the water, and an engine control computer mounted higher in the engine compartment to prevent damage from flooding. The City sold in Thailand in 2000 for $16,000, compared to $23,000 for a Civic.

Designing an Asia car required a delicate balancing act. A successful car had to be more rugged than models offered in Japan, to withstand the region's poor roads and threat of flooding. With average family size much

larger in the rest of Asia than in Japan, more people would try to squeeze into a car. To reduce the price, "nonessential" items, such as a heater, had to be removed. Yet the car had to be perceived by status-conscious buyers in Asia as virtually identical to the version sold in Japan. In 2000 the car was the ultimate status symbol throughout Asia for the emerging middle class—as it had been in the United States in 1900—and not merely a means of transport. Thus a car with a sleek appearance and trendy image would attract buyers, while an ugly, poor-quality car would be shunned.

China

The country that, more than any other, held the fate of the motor vehicle during the twenty-first century was China. China's Ninth Five-Year Plan in 1996 designated motor vehicle production as one of seven "pillar industries," giving it preferential treatment and investment priority. The government hoped that motor vehicle production would be one of the engines of economic growth in the world's most populous country during the early decades of the new century. The seven main elements of the Chinese government policy stuck eerily close to principles of Fordist production in the United States a century earlier:

1. *Accept that the desire to own a motor vehicle is universal among the Chinese people.* Millions of Chinese families bought their first refrigerator, telephone, washing machine, and television during the 1980s and 1990s. The government figured that demand for cars and computers came next. Even Chairman Mao's grandson Wang Xiaozhi told a reporter that he "dreamed of owning a car."[8]

2. *Concentrate early production on saturating the luxury market.* Fewer than 1 million private individuals owned cars in China in 2000, and 85 percent of the vehicles were owned by companies or the government. With average income about $1,000, and average price about $20,000, a new vehicle was affordable for only a handful of the wealthiest government officials and business executives. A century earlier in the United States, when average income was about $100, and average price was $2,000, motor vehicles were similarly purchased only by the very wealthy.

3. *Design a car that is simple and easy to put together.* The government-owned China North Industrial Group (Norinco) designed the Lucky Star, with nearly the same length, width, and weight as the Ford Model T a century earlier. Norinco created the prototype after foreign manufacturers

failed to provide satisfactory proposals. Lucky Star initially sold for about $6,500, ten times more than the original Model T a century earlier, but like the Model T, it sold for only one-third the average price for all vehicles sold at the time.

4. *Have a small number of manufacturers churn out large quantities of low-cost cars.* Rather than opening the Chinese market simultaneously to all producers, the 1994 China Automotive Industrial Policy designated three firms to be large-scale car makers.[9] The first was Shanghai-VW Automotive Company, a joint venture (owned 50 percent by Volkswagen and 50 percent by several Chinese firms, including Shanghai Automotive Industry Corporation and China National Automotive Industry Corporation), started in 1984 in Shanghai to build Santana compact cars. Santana accounted for half of the Chinese market in 2000, about the same market share captured by the Model T in the United States a century earlier. Second was First Auto Works (FAW)-VW Automotive Company Ltd., a joint venture between Volkswagen and First Auto Works, started in 1987 to produce Audis and Little Red Flags, which were essentially cheaper, bare-bones Audis, with Chrysler engines. Third was Dongfeng-Citroën Automobile Company Ltd. (also known as Second Auto Works, or SAW), a joint venture between Peugeot and Dongfeng Automotive, started in 1994 in Wuhan, Hubei Province, to produce compact cars. The government designated three companies to be smaller scale, second-tier producers: Beijing Jeep Company Ltd. (a joint venture between Beijing Automobile Works and DaimlerChrysler), started in 1984 to produce Jeep Cherokees; Tianjin Automotive Industry Corporation, established in 1984 to build a small car and a small minivan with technical assistance from Daihatsu, and later from Toyota; and Guangzhou Peugeot Motors Ltd. (a joint venture started in 1987 by the Guangzhou province government with Peugeot initially, and with Honda a few years later after Peugeot withdrew). Two others were later added to the list of small-scale producers: Chang'an Alto Vehicle Company (a joint venture among Chang'an Automobile, Suzuki Motor, and the Japanese company Nissho Iwai), started in 1991 in Chongqing, Sichuan Province, to build compact cars based on a Suzuki model and, a few years later, a Ford model; and Guizhou Yunque, established in Anshun, in southwestern China, in 1992, with technical assistance from Fuji Heavy Industries, to build a minicar called Rex. Companies frozen out of the car market by the government were allowed to manufacture trucks and

commercial vehicles. Jiangling Motors Corporation (30 percent owned by Ford) built nine- and twelve-passenger vans, cargo vans, and pickup trucks in Nanchang. (Ford got taxi companies to buy the vans and lease them to individuals.) Nanfang South China Motor Corporation (partially owned by DaimlerChrysler) built minivans in Zhanjiang and Hainan Island in Guangdong Province. Jinbei GM Automotive Company (a joint venture owned 30 percent by General Motors and 70 percent by Jinbei Automobile Company) built compact pickup trucks in Shenyang.

5. *Reduce per-unit production costs through high-volume production.* Only Shanghai VW Automotive Company was able to produce and sell more than a quarter-million vehicles per year before 2000. Tianjin produced 100,000 vehicles in 1998. Annual production at other companies was still in the 10,000–20,000 range.

6. *Pass along to consumers lower prices achieved from reduced per-unit production costs.* In 2000 China had not yet moved to this stage in mass production, which Ford Motor Company had achieved during the 1910s and 1920s.

7. *Plow receipts from higher sales into further reducing production costs, which further stimulates sales, and so on up the spiral of production and consumption.* Nor had China reached this point yet. In 1900, 16 million U.S. households owned 8,000 motor vehicles. A quarter-century later 25 million U.S. households owned 20 million motor vehicles. China's 400 million households owned 5 million motor vehicles in 2000. Will China's 500 million households own 400 million motor vehicles in 2025? Even if only 200 million, or only 100 million, Chinese households had motor vehicles in 2025, world production would have to expand dramatically to meet the demand. Which companies would make those vehicles, and where would they make them? The economic health of many companies and countries rested on these answers.

Conclusion

It is a dead moral certainty that infernal machine will frighten horses and endanger the lives of men, women, and children.

—*Encyclopaedia of South Dakota*

PRODUCING and selling motor vehicles changed remarkably little in the United States through most of the twentieth century. Ford's mass production techniques remained the basic form of arranging assembly plants. Hundreds of individual parts and components were attached to the frame or body by thousands of minimally skilled workers, each performing specific tasks in a logical sequence along a moving assembly line. And GM's differentiation of products based on economic class remained the basic form of selling vehicles through most of the twentieth century. A handful of large manufacturers that had survived the industry's early shakeout sold their vehicles to consumers through the intermediary of tens of thousands of dealerships owned by small independent businessmen.

The U.S. market changed during the second half of the twentieth century. Demand for vehicles that were smaller, more energy efficient, higher quality, and more rugged shattered the ladder of success that GM had perfected and others had emulated. American consumer preferences varied more widely by place of residence, gender, ethnicity, and age. Faced with a changing market, one-half of America's dealers went out of business during the second half of the twentieth century, leaving a smaller number of larger stores operating at smaller margins.

Japanese manufacturers seemed best prepared to meet the diverse and complex demands of American consumers. Through lean or flexible production, Japanese companies could turn out a wide variety of products in small batches utilizing trained teams of workers who attached components manufactured by independent suppliers. But lean production could not generate the return on investment Japanese companies needed to re-

main competitive over the long run with American and European companies. Surviving American, European, and Japanese firms broke down longstanding national barriers to combine elements of mass production and lean production into optimum or post-lean production.

Changes in the production and sale of motor vehicles initiated in the last years of the twentieth century will expand in the twenty-first. With diffusion of modular assembly, automotive factories will no longer closely resemble those of Henry Ford's day. At a modular assembly plant, vehicles can be constructed much more quickly in response to specific customers' orders, whether arranged through a dealer or other intermediary or placed directly with the factory. Engineering, which changed remarkably little during the twentieth century, will generate the first substantial modification in the functioning of motor vehicles since the triumph of the internal combustion engine back in 1900. Zero-emission engines, variable transmissions, and electronic controls of vehicle operations and performance will alter the way vehicles are produced and sold, as well as how they are operated.

A substantial growth in global production and sales of motor vehicles in coming decades seemed probable from the perspective of 2000. Projected growth in motor vehicle production and sales appeared especially strong for Asia and Latin America, where increased production was being put in place to meet demand fueled by rising incomes. In Europe and Japan, where motor vehicles outnumbered households—and, of course, North America, where motor vehicles even outnumbered licensed drivers—production and sales were still growing in 2000. In these regions the motor vehicle was destined to become such an ordinary commodity that a consumer routinely possessed more than one.

The rosy production and sales forecasts of 2000 may or may not actually reach fruition. Asia's volatility during the 1990s hinted at the hazard—if not folly—of forecasting future production and sales. Sales in Asia's eight largest markets excluding Japan—China, India, Indonesia, Malaysia, Philippines, South Korea, Taiwan, and Thailand—more than doubled between 1990 and 1996, from 2.5 million to 5.7 million vehicles. Analysts in the mid-1990s saw no reason to doubt that sales in the region would continue to climb in the late 1990s, to an expected 8.8 million in 2000. But the bottom fell out of the Asian market between 1996 and 1998: overall sales in the region declined 27 percent in just two years (46 percent excluding China and India), and regional sales reached only 5.8 million in 2000.

In the short run, the difference between selling 6 million vehicles and 9

million vehicles in Asia meant the difference between profit and loss for several manufacturers. In the long run, the unpredictability of the Asian market represented the most critical investment gamble for every car maker. About 15 percent of U.S. households purchased a new vehicle in 2000. To meet a comparable level of demand in Asia, world production would have to quadruple. If only 5 percent of Asian households bought a vehicle, world production would double. If sales remained flat in Asia, too many producers would be forced to chase too few consumers.

The government of China in 2000 strongly believed that the motor vehicle analogy to the United States a century earlier was valid. Ownership of motor vehicles in the United States soared during the first quarter of the twentieth century, when both incomes rose and production costs declined. Rising incomes fueled demand for motor vehicles in Asia and Latin America around 2000, but not yet visible in 2000 was a new Fordist or mass production revolution to make vehicles affordable for most Asians and Latin Americans.

Eighty-five-year-old automotive pioneer Henry Leland, founder of Cadillac and Lincoln, recalled in 1926 how he had been asked a quarter-century earlier, "When would the saturation point be reached?" He replied, "There would never be a saturation point. As long as there were people on Earth there would be a demand for automobiles."[1] The twenty-first century holds many uncertainties for motor vehicle producers, but one thing seems nearly certain: the desire to own a vehicle is widespread if not universal around the world, not just in the United States. The motor vehicle is still the best way to get somewhere—both literally, as a means of transport, and figuratively, as a measure of status.

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NOTES

PREFACE

Joost Dijkhuizen, Niels Wisse, and Bert Robben are three University of Utrecht students who studied at Miami University in 1997; the three of them attribute the quotation in the epigraph to the author.

CHAPTER 1 / From Fordist Production . . .

The chapter epigraph is drawn from Davies and Jones, "Memo of Conference with Mr. P. T. Martin, Mr. Harner and Mr. Dagner of the Ford Motor Co.," p. 1.

1. Clarke, "Crisis of Fordism or the Crisis of Social-Democracy?" p. 82.
2. Nevins, *Ford: The Times, the Man, the Company,* p. 480.
3. Ibid., p. 275; Epstein, *Automobile Industry,* p. 336; Pound, *Turning Wheel,* pp. 44–45.
4. Forbes and Foster, *Automotive Giants of America,* pp. 1–3.
5. Epstein, *Automobile Industry,* p. 336; Nevins, *Ford: The Times, the Man, the Company,* p. 275.
6. Rackham, "Memorandum of a Conference," p. 3.
7. Anderson, "Memorandum of Conference," p. 278.
8. MacManus and Beasley, *Men, Money, and Motors,* p. 56.
9. Rackham, "Memorandum of a Conference," p. 4.
10. Lacey, "Statement of Arthur J. Lacey, Esq.," pp. 132–33.
11. Arnold and Faurote, *Ford Methods and the Ford Shops,* p. 24; Nevins, *Ford: The Times, the Man, the Company,* pp. 453–54.
12. Epstein, *Automobile Industry,* pp. 46–47; Gartman, *Auto Slavery,* p. 34.
13. Bornholdt, "Interview with Oscar C. Bornholdt," pp. 2–3; Davies and Jones, "Memo of Conference with Mr. P. T. Martin, Mr. Harner and Mr. Dagner of the Ford Motor Co.," p. 1; Nevins, *Ford: The Times, the Man, the Company,* p. 364.
14. Nevins, *Ford: The Times, the Man, the Company,* p. 455.
15. The most detailed information about the layout of Highland Park at the birth

of the moving assembly line comes from a book written in 1914 by Horace L. Arnold, who used the pen name Hugh Dolnar. Henry Ford liked Arnold's writings and gave him access to company materials so that he could write the book about Highland Park. When Arnold died in 1915 with the manuscript not quite finished, Fay L. Faurote, an engineer who had worked for Olds and E. R. Thomas, completed the book. See Arnold and Faurote, *Ford Methods and the Ford Shops.* See also "Today's Final Line," pp. 16–17.

16. Arnold and Faurote, *Ford Methods and the Ford Shops,* pp. 112–15; Nevins, *Ford: The Times, the Man, the Company,* pp. 471–72.

17. Davies and Jones, "Memo of Conference with Mr. P. T. Martin, Mr. Harner and Mr. Dagner of the Ford Motor Co.," p. 1.

18. Ibid.; Ford, in collaboration with Crowther, *My Life and Work;* Nevins, *Ford: The Times, the Man, the Company,* pp. 474–75; Nevins and Hill, *Ford: Expansion and Challenge 1915–1933,* p. 261; Sorensen, *My Forty Years with Ford*; Yanik, "Trucks Proved Their Worth," p. 70.

19. Ford director of purchasing A. M. Wibel, quoted in Nevins, *Ford: The Times, the Man, the Company,* p. 475.

20. Nevins and Hill, *Ford: Expansion and Challenge 1915–1933,* pp. 391–92.

21. Arnold and Faurote, *Ford Methods and the Ford Shops,* pp. 16, 19.

22. Nevins, *Ford: The Times, the Man, the Company,* pp. 244–45.

23. Kraft, *Peace Ship.*

24. Ervin, *Henry Ford vs. Truman H. Newberry.*

25. See, for example, Miller, *Amazing Story of Henry Ford* (1922); Marquis, *Henry Ford* (1923); and Graves, *Triumph of an Idea* (1934).

26. Arnold and Faurote, *Ford Methods and the Ford Shops,* p. 16; Ford with Crowther, *My Life and Work,* pp. 216, 224, 248; Nevins and Hill, *Ford: Expansion and Challenge 1915–1933,* pp. 137–39.

27. Bennett, *We Never Called Him Henry,* pp. 47, 65, 164; Ford with Crowther, *My Life and Work,* pp. 206, 209–10.

28. Bernstein, *Turbulent Years,* p. 736; Ford with Crowther, *My Life and Work,* pp. 241, 245. See also Leonard, *Tragedy of Henry Ford.*

29. Nevins and Hill, *Ford: Expansion and Challenge 1915–1933,* pp. 311–22.

30. Louis Ferdinand, *Rebel Prince,* p. 261.

31. Herndon, *Ford: An Unconventional Biography,* p. 185.

32. See, for example, Richards, *Last Billionaire,* and Sward, *Legend of Henry Ford,* both published in 1948, a year after Ford's death.

CHAPTER 2 / . . . To Lean Production

The chapter epigraph is drawn from "Arrival of Haute Carture," p. 53.

1. Nevins and Hill, *Ford: Expansion and Challenge 1915–1933,* pp. 439–58.
2. Ibid., p. 457.
3. Chappell, "Transplants Ushered in Quality Revolution," p. 8N-X.
4. "Why Detroit Cannot Compete," p. 75.
5. Womack, Jones, and Roos, *Machine That Changed the World,* p. 13.
6. Womack, Jones, and Roos, *Machine That Changed the World,* pp. 96–98.

7. Versical, "Ford's Warning to Suppliers," p. 4.
8. Chappell, "Going for the Gold," p. 2I.
9. David Thusfield, Ford vice president of vehicle operations, quoted in Buss, "Good Old Ingenuity," p. 8N-J.
10. Womack, Jones, and Roos, *Machine That Changed the World,* pp. 90–91.
11. Buss, "Good Old Ingenuity," p. 8N-J.
12. Treece, "Nissan Woes Fuel Shoppers' Jitters," p. 16.
13. Guillermo, "Nissan Boosts Output," p. 28D.
14. Johnson, "Japanese Come Roaring Back," p. 1.
15. Ibid.
16. Connelly, "Native Tongue," p. 18I.
17. Keebler, "Staff of Life," p. 4I.
18. Treece, "Mazda Claims 18-Month Development Times," p. 36.
19. "World as a Single Machine," pp. 7–8.
20. Connelly, "Ford Cuts Trim Levels," p. 10.
21. Rubenstein, *Changing U.S. Auto Industry,* p. 228.

CHAPTER 3 / From Making Parts . . .

The chapter epigraph is drawn from "Did Ford Rouge Set Pattern for Toyota?" p. 42.

1. Epstein, *Automobile Industry,* p. 28.
2. Neimark, *Hidden Dimensions of Annual Reports,* p. 28.
3. Epstein, *Automobile Industry,* pp. 50–53; Pound, *Turning Wheel,* p. 88.
4. The Industrial Technology Institute (ITI) estimated that GM made only 45 percent of its parts; Ford, 38 percent; and DaimlerChrysler, 34 percent (Bradsher, "G.M.'s Labor Costs on Parts," p. C2.) The main cause of the discrepancy was the question of how to define "in-house" versus "outsourced": if a manufacturer made a component with materials, such as steel and rubber, purchased from other companies, should the component count as 100 percent in-house, or should the value of the purchased material contribute to the percentage outsourced?
5. Nevins and Hill, *Ford: Expansion and Challenge 1915–1933,* pp. 22, 201–2.
6. Ibid., pp. 203–4.
7. Ibid., p. 201.
8. Ibid., p. 221.
9. Barclay, *Ford Production Methods,* p. 17.
10. Ibid., p. 97.
11. "Pressed Steel Plant Open House 10/4-5-6/50."
12. Barclay, *Ford Production Methods,* pp. 36–37; "Glass Plant Open House 9/14/50"; Nevins and Hill, *Ford: Expansion and Challenge 1915–1933,* p. 230.
13. Barclay, *Ford Production Methods,* pp. 16–17.
14. Ibid., p. 20; Nevins and Hill, *Ford: Decline and Rebirth 1933–1962,* p. 323.
15. Nevins and Hill, *Ford: Expansion and Challenge 1915–1933,* pp. 485–87.
16. Nevins and Hill *Ford: Expansion and Challenge 1915–1933,* pp. 231–38; Nevins and Hill, *Ford: Decline and Rebirth 1933–1962,* p. 323.
17. Pound, *Turning Wheel,* p. 190.

18. Chrysler, *Life of an American Workman,* p. 143.
19. Pound, *Turning Wheel,* p. 84.
20. Durant, "True Story of General Motors," p. 12.
21. Ibid.
22. Cray, *Chrome Colossus,* p. 82.
23. Ibid., p. 88.
24. Durant, "True Story of General Motors," p. 12.
25. Kuhn, *GM Passes Ford,* p. 34.
26. Durant, "Letter from W. C. Durant to A. P. Sloan."
27. Epstein, *Automobile Industry,* p. 105.
28. Pound, *Turning Wheel,* p. 271.
29. Ibid., p. 272.
30. Scharchburg, "GM Story," p. 9.
31. Pound, *Turning Wheel,* pp. 135–39.
32. Madsen, *Deal Maker.*
33. Kuhn, *GM Passes Ford,* p. 71.
34. Pound, *Turning Wheel,* p. 188.
35. Cray, *Chrome Colossus,* pp. 190–91.
36. Durant, "True Story of General Motors," p. 12.
37. Frame, "Feds Took Fifteen Years," p. 124.
38. Kuhn, *GM Passes Ford,* p. 71.
39. Sedgwick, "Delphi's Independence Day," p. 8.
40. Connelly, "Ford Takes Glass Unit off the Block," p. 8.
41. Versical, "New Ford Parts Unit," p. 8.
42. Rubenstein, *Changing U.S. Auto Industry,* p. 102.
43. Holusha, "Ford Thinks Green for River Rouge Plant," p. 50.

CHAPTER 4 / . . . To Buying Parts

The chapter epigraph is drawn from Chappell, "Electronics Firms Dominate Supplier List," p. 29.

1. Chappell, "Time Trials," p. 17I.
2. Klier, "Agglomeration in the U.S. Auto Supplier Industry," p. 21; Rubenstein, "Evolving Geography of Production," p. 2.
3. "*Automotive News* Congress," p. 24B; Connelly, "Ford Seeks Fewer—But Better—Suppliers," p. 24B; Neimark, *Hidden Dimensions of Annual Reports,* p. 174; Sedgwick, "Suppliers Gobble, Grow," p. 1; Sherefkin, "D/C to Reduce Tier 1 Ranks," p. 55.
4. Plumb, "Perfect Fit."
5. Krebs, "Moods of 5 Decades," p. D34; Sawyers, "Days of the Duster," p. 56.
6. Kisiel, "Frame Supplier A.O. Smith," p. 4.
7. Child, "Steeled for a Fight," p. 1i.
8. Deutsch, "Deal Reached by Goodyear and Sumitomo," p. C5; Miller, "Big 3 Pick Tires," p. 24B.
9. Sedgwick, "Stopping Power," p. 75.
10. Ibid.; Sedgwick, "Suppliers Gobble, Grow," p. 1; Sedgwick, "ABS Price War," p. 1; Sedgwick, "Continental Complete 'Corner Strategy,'" p. 3.

11. Kisiel, "New Dakota Plant," p. 3.
12. Frame, "Olds Got a Handle on Buyers' Desires," p. 94.
13. Cruikshank and Sicilia, *Engine That Could*; "How Chrysler Helped Keep Cummins Afloat," p. 34J.
14. Kepp, "Lopez Goal," p. 50.
15. Kurylko, "Germany Drops Charges," p. 6; Posthuma and Arbix, "López Hits 'Plateau,'" p. 1; Schemo, "Is VW's New Plant Lean, or Just Mean?" p. C1; Sedgwick "VW, Suppliers Work Side by Side," p. 3.
16. Bradsher, "General Motors Plans to Build," p. C3; Miller, "Yellowstone Rubs UAW Wrong," p. 46; Sedgwick, "G.M. Seeks U.A.W. Deal," p. 3.

CHAPTER 5 / From Deskilling the Work Force . . .

1. Nevins, *Ford: The Times, the Man, the Company,* p. 578.
2. Gartman, *Auto Slavery,* p. 22.
3. Bornholdt, "Interview with Oscar C. Bornholdt," pp. 3–4.
4. Womack, Jones, and Roos, *The Machine That Changed the World,* p. 24.
5. Pound, *Turning Wheel,* p. 93.
6. Babson, *Working Detroit,* pp. 20–21.
7. Gartman, *Auto Slavery,* p. 26.
8. Nevins, *Ford: The Times, the Man, the Company,* p. 232.
9. Gartman, *Auto Slavery,* pp. 28–29.
10. Epstein, *Automobile Industry,* pp. 40–41.
11. Gartman, *Auto Slavery,* p. 24.
12. Womack, Jones, and Roos, *The Machine That Changed the World,* p. 22.
13. Gartman, *Auto Slavery,* p. 24.
14. Babson, *Working Detroit,* pp. 29–30.
15. Montgomery, *Workers' Control in America,* pp. 9–31.
16. Babson, *Working Detroit,* pp. 18–19.
17. Epstein, *Automobile Industry,* p. 35.
18. Gartman, *Auto Slavery*, p. 20.
19. Nevins, *Ford: The Times, the Man, the Company,* p. 464.
20. Womack, Jones, and Roos, *The Machine That Changed the World,* p. 27.
21. Ibid., p. 28.
22. Arnold and Faurote, *Ford Methods and the Ford Shops,* pp. 115–16.
23. Epstein, *Automobile Industry,* p. 44; Gartman, *Auto Slavery,* p. 41.
24. Gartman, *Auto Slavery,* p. 48.
25. Neimark, *Hidden Dimensions of Annual Reports,* pp. 43–44.
26. Gartman, *Auto Slavery,* pp. 34, 42.
27. Nevins, *Ford: The Times, the Man, the Company,* pp. 468–69.
28. Babson, *Working Detroit,* p. 20.
29. Ibid., pp. 20–21; Nevins, *Ford: The Times, the Man, the Company,* pp. 380, 513.
30. Babson, *Working Detroit,* p. 27; Gartman, *Auto Slavery,* p. 36.
31. Babson, *Working Detroit,* p. 23.
32. Ibid., p. 27.
33. Ibid., p. 26.

34. Ibid., p. 34.
35. Nevins, *Ford: The Times, the Man, the Company,* pp. 557–58.
36. Babson, *Working Detroit,* p. 53; Fine, *Automobile Worker under the Blue Eagle,* p. 4.
37. Widick, *Detroit,* p. 34.
38. Bernstein, *Turbulent Years,* pp. 738–39.
39. Ibid., p. 502; Babson, *Working Detroit,* p. 61.
40. Bernstein, *Turbulent Years,* p. 739.
41. Widick, *Detroit,* p. 36.
42. Bennett, *We Never Called Him Henry,* pp. 33–34.
43. Neimark, *Hidden Dimensions of Annual Reports,* p. 63.
44. Babson, *Working Detroit,* p. 66.
45. Ibid., pp. 66–67; Bernstein, *Turbulent Years,* p. 504.
46. Babson, *Working Detroit,* p. 65.
47. Bernstein, *Turbulent Years,* p. 373.
48. Ibid., p. 387.
49. Barnard, *Walter Reuther and the Rise of the Auto Workers,* p. 27.
50. Bernstein, *Turbulent Years,* p. 509.
51. Ibid., p. 500.
52. Neimark, *Hidden Dimensions of Annual Reports,* p. 67.
53. Bernstein, *Turbulent Years,* p. 517.
54. Ibid., pp. 524–25.
55. Ibid., pp. 741–42.

CHAPTER 6 / . . . To Reskilling Labor

The chapter epigraph is drawn from Rehder, "Japanese Transplants," p. 56.
1. Barnard, *Walter Reuther and the Rise of the Auto Workers,* pp. 138–39.
2. Bradsher, "At G.M., Can't They Get Along?" p. C1.
3. Rothenberg, "OPEC Proves It's a Small World," p. 30.
4. Bill Bowers, later president of the local, quoted in James Risen, "Lordstown's Blues Mellow with Age," p. D5.
5. Evanoff, "G.M. Weighs Scrapping Ohio Plant."
6. Sedgwick, "Harbour Says G.M. Boosts Efficiency," p. 24B.
7. Buss, "GM's Company Town," p. 28; Dandaneau, *A Town Abandoned*; Marbella, "GM Steering Flint's Future."
8. Biederman, "Mexico's Maquiladora Industry," p. 53.
9. Gates, "Great Debate," p. 36.
10. Ibid., p. 57.
11. Ibid., p. 56.
12. Buss, "Good Old Ingenuity," p. 8N-J.
13. Wright, "Staff Development," p. 8N-H.
14. Couretas, "Upward Mobility," p. 2I.
15. Parker and Slaughter, *Choosing Sides.*
16. "Nissan Doesn't Want Union at Smyrna, Runyon Says," p. 42.
17. Letter signed by S. Osakatani, assistant general manager in the office of the

president of Mitsubishi Motors Corp., to U.S. Rep. Mary Rose Oakar, explaining why her Cleveland, Ohio, district had been rejected as a site for a Mitsubishi plant; quoted in Jensen, "Mitsubishi-Chrysler Ventures," p. 1E.

18. Rehder, Hendry, and Smith, "Nummi," pp. 36–37.
19. Ibid., p. 40.
20. Rehder, "Japanese Transplants," p. 54.
21. Holusha, "No Utopia, But to Workers It's a Job," p. 1.
22. Chappell, "U.A.W. Battered in Nissan Vote," p. 2.
23. Jackson, "U.A.W. Concedes Defeat at Transplants," p. 8N-F.
24. Nevins and Hill, *Ford: Decline and Rebirth 1933–1962,* p. 305.
25. Bradsher, "At G.M., Can't They Get Along?" p. C6.
26. Chappell, "Louisville Sluggers," p. E26.
27. Chappell, "Transplants Ushered in Quality Revolution," p. 8N.
28. Connelly, "Ford Teams Track Down Problems," p. 52.
29. Bradsher, "At G.M., Can't They Get Along?" p. C6.
30. Meredith, "Ford's Deal with Auto Workers," p. C2.
31. Sedgwick and Frasier, "U.A.W. Targets Plants," p. 35.

CHAPTER 7 / From a Class-based Market . . .

1. Cray, *Chrome Colossus,* p. 327; Zim, Lerner, and Rolfes, *World of Tomorrow,* pp. 109–10.
2. Flink, *Automobile Age,* p. 70.
3. Cray, *Chrome Colossus,* p. 136.
4. Jackson, *Crabgrass Frontier,* p. 162.
5. Curcio, *Chrysler.*
6. Cray, *Chrome Colossus,* pp. 195–97.
7. Ibid., p. 214.
8. Crow, *City Of Flint Grows Up,* p. 74.
9. Quoted in Cray, *Chrome Colossus,* p. 82.
10. Kuhn, *GM Passes Ford,* p. 81.
11. Ibid., p. 113.
12. Bornholdt, "Interview with Oscar C. Bornholdt," p. 4.
13. Boorstin, *The Americans,* quoted in Skwira, "Annual Model System," p. 79.
14. Weisberger, *Dream Maker,* p. 164.
15. Cray, *Chrome Colossus,* p. 125.
16. Ibid., p. 127.
17. Ibid.
18. Scharchburg, "GM Story," p. 8.
19. Cray, *Chrome Colossus,* p. 75; Durant, "True Story of General Motors"; Pound, *Turning Wheel,* p. 94.
20. Scharchburg, "GM Story," p. 2.
21. Ibid.
22. Pound, *Turning Wheel,* p. 68.
23. Cray, *Chrome Colossus,* pp. 52–53.
24. Ibid., p. 36.

25. Ibid., p. 155; May, *A Most Unique Machine,* pp. 256–58; Pound, *Turning Wheel,* pp. 106–7.
26. Johnson, *American Railway Transportation,* pp. 149, 295.
27. Scharchburg, "GM Story," p. 1.
28. Ibid., p. 3.
29. Sloan, Trial Testimony, p. 2414.
30. Pound, *Turning Wheel,* pp. 86, 191.
31. Kuhn, *GM Passes Ford,* p. 57.
32. Quoted in ibid., p. 56.
33. Flink, *Automobile Age,* pp. 278–79.
34. Kuhn, *GM Passes Ford,* pp. 59–60.
35. Bernstein, *Turbulent Years,* p. 512.
36. Sloan, Trial Testimony, pp. 2412–21.
37. Kuhn, *GM Passes Ford,* p. 58.
38. Flink, *Automobile Age,* p. 287.
39. Cray, *Chrome Colossus,* p. 373.
40. Ibid., p. 427.
41. Ibid., pp. 410–11.
42. Hearings 1968, pp. 966–68.
43. Drucker, *Adventures of a Bystander,* p. 293.
44. Bernstein, *Turbulent Years,* p. 513.
45. Keller, *Rude Awakening,* p. 47.
46. Flink, *Automobile Age,* p. 286.
47. Cray, *Chrome Colossus,* p. 375.
48. Couretas, "The '50s Stressed Styling," p. 105.
49. Greene, "'57 Thunderbird May Fly Again," p. A10.
50. Bisson, "What *Won't* Change," p. 2FS.
51. Greene, "'57 Thunderbird May Fly Again," p. A10.

CHAPTER 8 / . . . To a Personal Market

1. Cray, *Chrome Colossus,* p. 363.
2. Ibid., pp. 323–26.
3. Wernle, "Romney Had a Mission and a Dream," p. 106.
4. Cray, *Chrome Colossus,* pp. 506–9.
5. Arnold and Faurote, *Ford Methods and the Ford Shops,* p. 20; Cray, *Chrome Colossus,* p. 376.
6. Freedman, "Goodbye, Gas Guzzlers," p. 131.
7. Bradsher, "Auto Makers Seek to Avoid Mileage Fines," p. A14.
8. "Jeep Has Been Long Coveted," p. 18.
9. Bradsher, "Trucks, Darlings of Drivers," p. 1; Bradsher, "Making Tons of Money and Fords, Too," p. 14.
10. Kurylko, "CAFE Adherence," p. 136.
11. Stoffer, "Big 3 CAFE Scramble Continues," p. 25.
12. Bradsher, "What Not to Drive to the Recycling Center," p. 4.

13. Bradsher, "Study Ties Sport Utility Vehicle Hazard," p. A11; Bradsher, "Auto Makers Seek to Make Light Trucks Safer," p. C1.
14. Rechtin, "Breathing Easy," p. 152.
15. Ibid.
16. Stoffer, "N.Y. Leads Assault on Emissions," p. 4.
17. Winfield, "GM EV1," pp. 78–83.
18. Rechtin, "GM EV1: Not Ready for Prime Time," p. 14.
19. Pollack, "Charge! Doing an Electric Commute," p. 30.
20. "New Batteries Required," p. 87.

CHAPTER 9 / From Dealing with Customers . . .

The chapter epigraph is drawn from Bradsher, "Don't Trust Car Dealer?" p. 1.
1. Parlin and Youker, "Automobiles Volume 1B," pp. 101, 256.
2. Bury, *Automobile Dealer,* pp. 48, 327.
3. Caliper Human Strategies, Inc. administered a two-hour test at 139 U.S. dealerships to the 320 "best" salespeople—defined as those who sold the most vehicles—and developed a twenty-three-item profile for *Automotive News.* Reported in Sawyers, "Top Salespeople," p. 41.
4. Parlin and Youker, "Automobiles Volume 1B," p. 1200.
5. Ibid., p. 1235.
6. Ibid., pp. 100–101.
7. Epstein, *Automobile Industry,* p. 140.
8. Nevins, *Ford: The Times, the Man, the Company,* p. 249.
9. Epstein, *Automobile Industry,* p. 140; Harris, "Early Car-Dealer 'Agents,'" p. 14; Nevins, *Ford: The Times, the Man, the Company,* p. 249.
10. Parlin and Youker, "Automobiles Volume 1B," pp. 111–12.
11. Ibid., p. 13.
12. Ibid., pp. 14, 256.
13. Ibid., p. 14.
14. Epstein, *Automobile Industry,* pp. 95–97.
15. Ibid., pp. 154, 298.
16. Krebs, "Model Behavior," p. 5I; Vettraino, "Money Magnet," p. 2I.
17. Epstein, *Automobile Industry,* p. 85.
18. Ibid., pp. 89–90.
19. Ibid., p. 86.
20. Nevins, *Ford: The Times, the Man, the Company,* p. 249.
21. Ibid., pp. 346, 388.
22. Epstein, *Automobile Industry,* pp. 91–92.
23. Georgano, *American Automobile, A Centenary,* pp. 15–16; Nevins, *Ford: The Times, the Man, the Company,* pp. 139–40; Wren, "1895 Chicago Race," p. 30.
24. Epstein, *Automobile Industry,* p. 160.
25. Scharchburg, *Carriages without Horses*; Scharchburg, "Day of the Duryea," p. 24.

26. Duerksen, "Oldsmobile," p. 14.
27. Epstein, *Automobile Industry,* pp. 155, 159.
28. Levine, "Happy Anarchy," p. 32.
29. Nevins, *Ford: The Times, the Man, the Company*, pp. 203–4.
30. Davidson, "Indy 500 Started Modestly," p. 50.
31. Epstein, *Automobile Industry,* p. 161.
32. Eckberg, "Race for the Money," p. E4.
33. Hastings, "Memorandum of Interview," p. 2.
34. Goodenough, "Statement on Behalf of Messrs. David and Paul Gray, and Philip Gray, Deceased," pp. 183–84.
35. Anderson, "Memorandum of Conference," pp. 282–83.
36. Hawkins, "Affidavit before the Solicitor of Internal Revenue," pp. 195–96.
37. Parlin and Youker, "Automobiles Volume 1B," p. 228.
38. Boyer, "Ford Motored into Cincinnati Long Ago," p. E1; Knudsen, "Memorandum of Interview," p. 6.
39. Parlin and Youker, "Automobiles Volume 1B," p. 892.
40. Epstein, *Automobile Industry,* pp. 144–45.
41. Ibid., p. 135; Knudsen, "Memorandum of Interview," p. 6.
42. Epstein, *Automobile Industry,* pp. 135–36.
43. Ibid., pp. 133–34, 143.
44. Nevins and Hill, *Ford: Decline and Rebirth 1933–1962,* p. 379; Pound, *Turning Wheel,* pp. 427–31.
45. Bury, *Automobile Dealer,* p. 303; Epstein, *Automobile Industry,* p. 356; Parlin and Youker, "Automobiles Volume 1B," p. 110.
46. Parlin and Youker, "Automobiles Volume 1B," p. 110.
47. Bury, *Automobile Dealer,* pp. 37, 40.
48. Bornholdt, "Interview," p. 7.
49. Parlin and Youker, "Automobiles Volume 1B," pp. 278–79.
50. Ibid., p. 9.
51. Epstein, *Automobile Industry,* p. 140; Parlin and Youker, "Automobiles Volume 1B," pp. 785–86.
52. Parlin and Youker, "Automobiles Volume 1B," p. 786.
53. Ibid., pp. 789–90.
54. Ibid., p. 787.
55. Ibid., p. 786.
56. Hurley, "Automobile Industry," p. 6.
57. Bury, *Automobile Dealer,* p. 302.
58. Epstein, *Automobile Industry,* pp. 112, 114.
59. Parlin and Youker, "Automobiles Volume 1B," pp. 7, 9.
60. Epstein, *Automobile Industry,* pp. 40–41.
61. Parlin and Youker, "Automobiles Volume 1B," p. 8.
62. Parlin and Youker, "Automobiles Volume 1B," p. 8; Epstein, *Automobile Industry,* p. 225.
63. Epstein, *Automobile Industry,* pp. 138–39.
64. Pound, *Turning Wheel,* p. 59.

65. Parlin and Youker, "Automobiles Volume 1B," p. 453.
66. Ibid., pp. 453–55.
67. Epstein, *Automobile Industry,* pp. 116–17.
68. Child, "'Buy Now, Pay Later,'" p. 72; Kuhn, *GM Passes Ford,* p. 80.
69. Epstein, *Automobile Industry,* pp. 119–20.
70. Child, "'Buy Now, Pay Later,'" p. 72.

CHAPTER 10 / . . . To Serving Customers

The chapter epigraph is drawn from Passell, "How G.I. Joe's Little Jeep Grew," p. D7.

1. Myerson, "Ford or Honda, New or Used," p. D4.
2. Connelly, "Mixed Bag in Tulsa," p. 32.
3. Bury, *Automobile Dealer,* p. 295.
4. Tonkin, "Drastic Changes in Car Retailing," p. 42.
5. Sawyers, "Study: Good Service," p. 6.
6. Bury, *Automobile Dealer,* p. 29; Epstein, *Automobile Industry,* pp. 148–49.
7. Bury, *Automobile Dealer,* pp. 31–33.
8. Harris, "NADA Goal," p. 22.
9. Bradsher, "AutoNation to Close Stores," p. C6; Bradsher, "Breakdown on the Sales Lot," p. C8.
10. Verhovek, "Git Along," p. D8.
11. Brooke, "Four-Wheel Ice Follies," p. D8.
12. Weinraub, "Hollywood Fades to Black," p. D8.
13. Nevins and Hill, *Ford: Expansion and Challenge 1915–1933,* p. 406.
14. Connelly, "From Vehicle Design to Retail," p. 3.
15. Parlin and Youker, "Automobiles Volume 1B," pp. 993, 996.
16. Ibid., p. 1000.
17. Rechtin, "Hardtops Charmed a Generation," p. 104.
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19. Drucker, *Adventures of a Bystander,* pp. 268–69.
20. Widick, *Detroit,* p. 222.
21. Jackson, "Stallkamp Leads," p. 3.
22. Babson, *Working Detroit,* p. 35; Widick, *Detroit,* pp. 26, 30.
23. Widick, *Detroit,* p. 66.
24. Chappell, "Toyota Praised," p. 3.
25. Rubenstein, *Changing U.S. Auto Industry,* p. 261.
26. Schlesinger, "Fleeing Factories," p. 28.
27. Jackson, "Chrysler Ads Win Black Buyers," p. 3.
28. Kurylko, "Ford Had a Better Idea," p. 113.
29. Cray, *Chrome Colossus,* p. 413.

CHAPTER 11 / From a National Market . . .

The chapter epigraph is drawn from Lynd and Lynd, *Middletown,* as quoted in Cray, *Chrome Colossus,* p. 265.

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2. Cook, Gittell, and Mack, eds., *City Life,* p. 155.
3. Ibid., p. 60.
4. Schlesinger, *Rise of the City,* pp. 91–92.
5. See Warner, *Streetcar Suburbs.*
6. Chudacoff, ed., *Major Problems in American Urban History,* p. 315; Interrante, "Road to Autopia," p. 506.
7. Meyer, Kain, and Wohl, *Urban Transportation Problem,* p. 68.
8. Epstein, *Automobile Industry,* p. 17.
9. Schlesinger, *Rise of the City,* p. 88.
10. Nevins, *Ford: The Times, the Man, the Company,* p. 4; Schlesinger, *Rise of the City,* pp. 88–89.
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12. Cray, *Chrome Colossus,* p. 265.
13. Schlesinger, *Rise of the City,* pp. 58–61.
14. Cray, *Chrome Colossus,* p. 265.
15. "Digital Audio," p. 74.
16. Newman, "From the Land of Private Freeways," p. D8.
17. Konrad, "Drive to the Future."
18. Gates, "Domestic Content Labels Arrive," p. 36.
19. Bohn, "Under Lutz," p. 44.
20. Chappell, "Empty Nest," p. 1; Jackson and Kurylko, "When Ford Totes It Up," p. 1; Keebler, "Standing on Tradition," p. 1I.
21. Cray, *Chrome Colossus,* p. 400.
22. "GM Freight Charges," p. 57.
23. Disclosure, Inc., *Corporate Information*; "Cross Ownership," p. 29; *Japan Company Handbook*; *Japan Company Datafile.*
24. Gregor, *Daimler-Benz.*
25. Ryback, "Man Who Swallowed Chrysler," p. 88.
26. Stoffer, "'Domestics' and 'Imports,'" p. 8N-T.

CHAPTER 12 / . . . To a Global Market

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2. Nevins and Hill, *Ford: Expansion and Challenge 1915–1933,* pp. 541–69; Pound, *Turning Wheel,* pp. 243–65.
3. Ibid., p. 77–108.
4. Halberstam, *Reckoning;* Miyakawa, "Transformation of the Japanese Motor Vehicle Industry," pp. 88–113; WuDunn, "Uphill Journey," p. C1.
5. Studer, "Impact of NAFTA," p. 27.
6. Bennett and Sharpe, *Transnational Corporations*; Werner, "Makers Breaking Rules"; Werner, "Sixty-eight Years of Feast or Famine," p. 37.
7. Addis, *Taking the Wheel.*
8. Ibid.

9. Sit and Liu, "Restructuring and Spatial Change of China's Auto Industry under Institutional Reform and Globalization," p. 662.

Conclusion

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